Science Education

THE RELATIVE VALUE OF SOUND AND SILENT MOTION PICTURES IN SCIENCE TEACHING *

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Efficiency in work should be just as important to the educator as to those in industrial and commercial life. One of the ways in which the educator has attempted to increase his efficiency is by the use of motion pictures. In the industrial, commercial, and theatrical fields the motion picture has gained great popularity. The value and proper use of motion pictures in the classroom is not to be determined by mere opinion or theory, but must meet the test of scientific investigation.

The study here reported is the third study conducted by the writer [1, 2] comparing sound motion pictures with some other method of direct teaching.

EXPERIMENTAL PROCEDURE

This investigation was made to determine the relative value of two methods of direct instruction: (1) the use of educational sound motion pictures; and (2) the use of the same films shown silently and with the use of captions. All instruction was given by the use of mechanical devices, thus the different abilities of the instructors were not factors in this experiment. The data were collected during the first semester of the school year of 1939–1940 in the Horace Mann Junior High School of Tulsa, Oklahoma. Eighth-grade science pupils were paired according to mental age, science reading ability, and sex. There were 152 pairs remaining at the end of the experiment.

Eight sound motion pictures on science subjects produced by Erpi Classroom Films, Inc., were selected. Four teaching units were made of these by combining them as follows: "Ground Water" and "Volcanoes in Action," "The House Fly" and "The Geological Work of Ice," "Water Power" and "Conservation of Natural Resources," and "The Work of Rivers" and "The Work of the Atmosphere." Captions were put on slides for each sound film so that when the film was shown silently with the slides, the captions would explain the details of the film.

Multiple choice tests were constructed for each unit of instruction. Each test consisted of fifty-six items, twenty-eight for each of the two subjects of the unit. The reliability of each test was determined by the chance halves method, after which the Spearman-Brown formula was applied. The reliabilities of the tests ranged from .839 to .892.

On the first day of experimental teaching, one group was taught by the use of the sound motion pictures and the other group by the use of the same films shown silently with captions. Each film was viewed twice by the pupils. No comments were made by the teachers concerning the content of the instructional matter. The day after teaching, the tests based on the unit taught were administered to all pupils. Thirty days later they were tested

* Field Study No. 3, Colorado State College of Education, Greeley, Colorado, 1940.

[1] Maneval, R. V. "The Relative Value of Sound Motion Pictures and Study Sheets in Science Teaching." *Science Education* 23: 83–86; February, 1939.

[2] Maneval, R. V. "The Relative Value of Sound Motion Pictures and Study Sheets in Science Teaching." *Journal of Experimental Education* 13: 39–43; September, 1939.

for delayed recall. The groups were then rotated before each of the next three units of teaching.

STATISTICAL TREATMENT OF DATA

The means for the scores on each test were computed, both for immediate and delayed recall. This was done separately for each unit of teaching, and for each of the two methods of teaching.

The formula given by Peters and Van Voorhis[3] was used for determining the S. E.'s of the differences of the means, when the pupils are paired on a fallible criterion:

$$\sigma_{m_x - m_y} = \frac{\sigma_d}{\sqrt{N}} \left(\sqrt[4]{1-r_{xc}^2}\ \sqrt[4]{1-r_{yc}^2} \right)^*$$

[3] Peters, C. C., and VanVoorhis, W. R. *Statistical Procedures and Their Mathematical Bases*, p. 144. State College, Pennsylvania: The Pennsylvania State College, 1935.

* The σ_d refers to the standard deviation of the differences between test scores of each pair. The r_{xc} refers to the correlation between test scores by one method and composite scores, or the scores used for the purpose of matching; and r_{yc} refers to the correlation between test scores of the second method and the composite scores.

The experimental coefficients were determined by dividing the differences of the means by 2.78 times the S. E. of the difference of the means.

In Table I are shown the means of the test scores, the differences of the means, the S. E.'s of the differences of the means, and the experimental coefficients, when the tests were used for immediate and delayed recall. For both immediate and delayed recall, three of the four experimental coefficients are statistically significant, and in favor of the silent film method of teaching.

A further study of the data was made by dividing the test scores of the pupils into three groups, according to composite pairing scores. The three groups used were: (1) above the seventy-fifth percentile, (2) between the seventy-fifth and twenty-fifth percentiles, and (3) below the twenty-fifth percentile. The same procedure as that given above was used in calculating the experimental coefficients of these groups. The differences of the means, their corresponding S. E.'s, and the experimental coefficients are given in

TABLE I

THE MEANS, THE DIFFERENCES OF THE MEANS, S. E.'S OF THE DIFFERENCES OF THE MEANS, AND THE EXPERIMENTAL COEFFICIENTS, WHEN THE TESTS WERE USED FOR IMMEDIATE AND DELAYED RECALL, IN A STUDY INVOLVING TWO GROUPS OF 152 CASES EACH

Subjects	Means		Differences of means	S. E.	Experimental coefficients
	Silent film	Sound film			
Immediate recall:					
1. Ground Water and Volcanoes in Action	35.84	32.38	3.46	.436	2.86
2. House Fly and Geological Work of Ice	38.80	37.09	1.71	.368	1.68
3. Water Power and Conservation of Natural Resources	38.68	39.05	−.37	.351	−.38
4. Work of Rivers and Work of Atmosphere	35.95	33.80	2.15	.380	2.03
Delayed recall:					
1. Ground Water and Volcanoes in Action	33.28	31.11	2.17	.391	1.99
2. House Fly and Geological Work of Ice	36.71	35.35	1.36	.363	1.35
3. Water Power and Conservation of Natural Resources	36.00	36.33	−.33	.332	−.36
4. Work of Rivers and Work of Atmosphere	33.68	32.10	1.58	.369	1.53

TABLE II

THE DIFFERENCES OF THE MEANS, THEIR CORRESPONDING S. E.'S, AND THE EXPERIMENTAL COEFFICIENTS OF TEST SCORES OF PUPILS DIVIDED INTO THREE GROUPS ACCORDING TO COMPOSITE PAIRING SCORES, (A) ABOVE THE SEVENTY-FIFTH PERCENTILE, (B) BETWEEN THE SEVENTY-FIFTH AND TWENTY-FIFTH PERCENTILES, AND (C) BELOW THE TWENTY-FIFTH PERCENTILE, WITH TWO METHODS OF TEACHING, WHEN THE TESTS WERE USED FOR IMMEDIATE AND DELAYED RECALL

Subjects	Differences of means			S. E.			Experimental coefficients		
	A	B	C	A	B	C	A	B	C
Immediate recall:									
1. Ground Water and Volcanoes in Action	4.79	3.47	2.10	1.50	1.04	1.48	1.15	1.20	.51
2. House Fly and Geological Work of Ice	2.81	1.01	1.97	1.18	.82	1.38	.86	.44	.51
3. Water Power and Conservation of Natural Resources	.37	-.22	-1.40	.96	.94	1.18	.14	.08	-.42
4. Work of Rivers and Work of Atmosphere	2.52	1.92	2.24	1.50	.98	1.45	.60	.71	.56
Delayed Recall:									
1. Ground Water and Volcanoes in Action	3.45	1.58	2.05	1.30	.94	1.44	.96	.61	.51
2. House Fly and Geological Work of Ice	2.66	.48	1.81	1.18	.86	1.46	.81	.20	.45
3. Water Power and Conservation of Natural Resources	.37	-.63	-.42	.98	.89	1.14	.14	-.26	-.13
4. Work of Rivers and Work of Atmosphere	1.64	1.52	1.66	1.45	.96	1.39	.41	.57	.42

Table II. Of the twenty-four experimental coefficients, only two are large enough to be considered statistically significant. These two are for the upper and middle ability groups for immediate recall, for the first unit of teaching, and are in favor of silent films. Only four of the differences are in favor of sound films, and they are not statistically significant.

The data secured were also studied by combining each pupil's scores for the two units taught by each method. These values were placed in two frequency distributions. The means and the differences of the means for the two methods of teaching were calculated. By this treatment each pupil was represented by a score for each of the two methods, which would correspond to pairing on the basis of a true criterion.

For computing the S. E.'s of these differences, the formula given by Peters and VanVoorhis[4] was used:

$$\sigma_{m_x - m_y} = \frac{\sigma_d}{\sqrt{N}} \left(\sqrt[4]{1 - r_{x_1 x_2}} \sqrt[4]{1 - r_{y_1 y_2}} \right) *$$

In this case these values would be the same, which would be the reliability of the four tests considered as one test. This reliability was found to be .96 for the whole test of 224 items. For immediate recall and delayed recall, the differences of the means were 3.50 and 2.39 respectively in favor of the silent film method of teaching. The S. E.'s were .110 and .104 respectively; and the experimental coefficients were 11.44 and 8.27 respectively.

[4] Peters, C. C., and VanVoorhis, W. R. *Op. cit.*

* The σ_d refers to the standard deviation of the differences between test scores of each pair. The $r_{x_1 x_2}$ and $r_{y_1 y_2}$ are the reliability coefficients of the measuring instruments.

CONCLUSIONS

In this study the sound motion picture and silent motion picture methods were compared as to their effectiveness for direct teaching.

When the data from each unit taught are studied separately this experiment fails to give statistically significant evidence to show that either method is the better. The data secured tend to show that the silent film was better in that three of the four units gave differences that were statistically significant both for immediate recall and delayed recall. Previous instruction and the general nature of the two films, "Water Power" and "Conservation of Natural Resources," may have influenced the results of the one unit which failed to show statistically significant evidence.

When the pupils are divided into ability groups and their test scores studied, it can be seen that those pupils of higher mental ability tend to be taught better by the silent film method, and those having lower mental ability tend to use the sound film method to a better advantage. Possibly reading difficulties were overcome partially by the use of the sound films.

When each pupil's test scores for the two units were combined for each method, the data gave statistically significant differences in favor of the silent film method. It should be noted that the results of this experiment have significance only for populations of which the sample used in this experiment is representative.

FUNCTIONAL CHEMISTRY IN THE JUNIOR HIGH SCHOOL

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In the spring of 1938 a questionnaire of 100 items was given to 300 students in the junior high school in Cheyenne, Wyoming, in an attempt to determine a few of their most important problematic life situations which involved a knowledge of chemistry, and to ascertain to what extent the felt needs and desires thus found depended on or varied with the grade, sex, quartile rank of the pupil in school achievement, and the supporting occupation of the home from which he came.

Although there are several investigations based upon spontaneous questions asked by grade and secondary school children,[1, 2, 3, 4, 5] no previous studies were found in the field of chemistry which considered directly the student of junior high school age asking him what he thought science could contribute to his daily life.

It is still widely felt that, although the general science texts published today show a great improvement over those of several years ago, they still deal far too much with those topics which are of classroom interest only and touch lightly if at all on those problems which the students feel that they need or want to know about.

[1] Curtis, Francis Day. *Some Values Derived From Extensive Reading of General Science.* Contributions to Education, No. 163. Teachers College, Columbia University, New York, 1924.

[2] Craig, Gerald S. *Techniques Used for Developing a Course of Study in Science.* Contributions to Education, No. 276. Teachers College, Columbia University, New York, 1927.

[3] Robertson, Martin L. *A Basis for the Selection of Course Content in Elementary Science.* Unpublished Doctor's Dissertation, University of Michigan, 1925.

[4] Burkhart, Oscar C. *Concepts of Pupils in Secondary School Science.* Unpublished Master of Arts Thesis, Colorado State College of Education, Greeley, Colorado, 1928.

[5] Flack, F. E. *Children's Interests in High School Chemistry in Terms of Questions Asked.* Unpublished Master of Arts Thesis, Colorado State College of Education, Greeley, Colorado, 1935.

If we accept as a principle of education that meaningful teaching must deal largely with the present interests of the students, we must analyze the lives of those students so as to determine what problems, principles and generalizations are of most importance to them. We should then concentrate on the mastery of those things which are most important for their present and future welfare, leaving the rest of the mass of scientific information for those persons who wish to delve into those fields for purposes other than general education.

LIMITATIONS OF THE STUDY

The limitations of the investigation are: first, the practical length of a questionnaire which can be submitted to junior high school students; second, the inclusion of only those problems which could be stated in a very brief and simple form; third, the possible extent to which the children's interests and felt needs should determine the subject matter of their classrooms; fourth, the limiting of the investigation to the students of a single school; and fifth, the fact that only 300 questionnaires were accepted from a school with an enrollment of 1190.

THE QUESTIONNAIRE

After each problem included in the questionnaire there were three columns headed "need," "desire," and "never." The students were instructed to place a check in the column under "need" if, outside of school, they had ever needed to know the answer to the problem whether they knew the answer or not, to place a check in the "desire" column if they had ever wanted to know concerning the problem, and to place a check in the "never" column if the problem had never been of importance to them.

A subjective list of problems for the questionnaire was gathered from a number of sources. It was improved by having a jury of science and English teachers examine each question as to its chemistry and language content. A seventh grade class was then given the questionnaire and told to indicate any problems which were meaningless to them. Those which could not be simplified so as to bring them within their comprehension were eliminated.

This produced a final list of 97 problems (which was rounded out to 100) which was used in the investigation. An analysis of these 97 problems showed that all of the major fields of chemistry were represented, though some better than others. There were enough problems in each field for the students to indicate any which might be of unusual value to them.

The questionnaire was administered according to accepted testing technique.

THE STUDENT SAMPLE

Cheyenne, Wyoming, depends largely upon the transportation industries, i.e., railroads, air lines, and truck lines, for its existence. In order to counterbalance this one-sided occupational background, the group of students given the questionnaire was chosen in such a manner that their parental occupations represented a vocational cross-section of the country as given by the 1930 census.[6] The ten main occupational classifications were used in the same percentages given there and their sub-divisions ignored.

The student sample was also balanced according to grade, sex, and the quartile rank of the students in school achievement.

The questionnaire in its final form was given to one hundred students selected from each of the junior high school grades.

Besides their differences in age and maturity, the students in the three grades varied in another important respect. The one year course in general science is placed in the eighth grade in the school studied and since the questionnaire was distributed during the late spring, the following facts are of importance: the seventh grade students had had no formal science course in this school system, the eighth grade

[6] World Almanac, 1932, p. 864.

pupils were finishing their one year general science course, and the ninth grade students had had general science the preceding year, but no formal science during their ninth grade.

TREATMENT OF THE DATA

A preliminary examination of the papers was made after they were handed in and those showing long, uninterrupted lines of checks in the same column were discarded as showing a lack of discrimination on the part of the student, and additional students substituted to maintain the balance of the student sample.

The following method was used for ranking the problems after obtaining the answer frequencies from a group: The checks in the "never" column of a problem were arbitrarily assigned values ranging from .00 to .99, those in the "desire" column values ranging from 1.00 to 1.99, and those in the "need" column values ranging from 2.00 to 2.99. It was further assumed that the total frequencies within any one column were evenly distributed throughout the range of values for that column, i.e., if a student group placed seventeen checks in the "never" column of a problem, it was assumed that the true values of those checks were evenly distributed from .00 to .99. The median value of the problem was then calculated to two decimal places and this number called the score value for that problem.

In order to compare the scores thus found, the total range of the score values of the complete test was found for a given student group and this range divided into ten equal parts. The questions were then assigned a number from one to ten depending upon their range group. These numbers were then called the range decile ranks of the problems.

While it is customary to base decile ranks upon the total number of problems rather than the range of scores, for the purposes of this study it was felt that basing them on the range would better point out those problems which the students considered to be of outstanding value.

In every distribution curve there is a wide variation in the scores at the top and bottom of the frequency curve and in finding the usual decile or quartile points, these cases of great difference in value are thrown together and most of the distinction between them lost. On the other hand, the decile ranks of those cases lying near the mode may easily shift two or three deciles with but little change in their score value, thus making large distinctions where only very small ones exist. Since the objectives of this study would best be served by pointing out those problems which have an exceptionally high or an exceptionally low value, it seemed preferable to use the decile points based upon the range.

FINDINGS

In comparing the rankings given to the problems by the three grade groups, it was found that there was a correlation of .76 with a PE. of .03 between the seventh and eighth grades, a correlation of .70 with a PE. of .03 between the seventh and ninth grades, and a correlation of .93 with a PE. of .01 between the eighth and ninth grades.

Since the eighth grade group is between the other two grades in chronological age and experience, it might have been expected that there would be as much difference between this grade and the one below it as between it and the ninth grade. The above results show that for this particular study, this is not the case.

It is also to be noticed that the correlation between the seventh and ninth grades is .70 which shows that so far as this test is concerned, the seventh grade needs are as close to the ninth as they are to the eighth grade.

One of the basic weaknesses of the method used in this survey is that, for the results to be valid, one must first assume that the persons questioned are

fully aware of all of the ways in which they might be benefited by the science under consideration.

True, the seventh-grade rankings probably give a good picture of what they think is important, but those students who are only a year or two older disagree somewhat with them. This disagreement might be based upon the above mentioned fact that the eighth grade students had taken a course in science in which new things were pointed out to them—things which a year later still have a place of need and meaning in their lives as ninth grade pupils. This tends to make it necessary to regard the seventh grader as a person who is not yet aware of many of the things he really needs to know about and also raises the question as to whether or not the eighth and ninth grade responses would have been different if they had had more than a single year of formal science.

While it might be expected that those students who had reached the greatest achievement would have needs and desires which were much different from the slower students of their grade, the above discussion showing the high correlation between the felt needs of the students in all three of the junior high school grades would tend to indicate that so long as a student could be classed as belonging to these ages in maturity and experiences, his needs will be about the same as the other students in those grades. Since it is only the very exceptional student who will be more than a year or so advanced or retarded in comparison with his classmates, we might then reason that the difference between the bright and slow students within the same grade of a given school will not be so great as might have been expected.

A breakdown of the results verified this conclusion since, in the eighth and ninth grades where the results were considered most reliable, there were only two of the 100 problems on which their first and fourth quartile students differed by as much as three rank units on the values they assigned to them.

The rankings assigned by the various occupational groups were in a high state of agreement. In spite of the number of group rankings being considered simultaneously, in 71 of the 100 problems there was a variation of three or less in the ranks assigned to a particular problem. In the cases where the agreement was less, it was most frequently one of the smaller occupational groups which varied from the others in the results of their checking and suggests that the small numbers in these lesser groups might be the underlying reason for this variation. In any case, the occupational differences found here were small enough to be ignored.

It would be very interesting to see the results of a similar study made in a locality with an entirely different occupational background to see to what extent the interests and felt needs of the pupils are influenced by the main occupation of the community in which they live even though their own livelihood does not directly come from that occupation. Such comparisons could provide a basis for determining the extent to which school materials need to be modified for use in different communities.

The sex differences in ranking the problems were about what would be surmised.

The problems which both sexes of the eighth and ninth grades agreed should be ranked as being of great importance are seen in Table I to deal with those things which effect them personally, i.e., personal health, clothing and food.

Conversely, they place almost at the bottom those problems dealing with the manufacture of materials which have little functional use in their lives. At the very bottom of the list (see Table II) are placed the concept of "atom," "element," "alloy," and the simplest and most common chemical formulas.

This study would seem to indicate that science teachers should hold a check rein

TABLE I

MAIN WORDS OF HIGH RANKING PROBLEMS OTHER THAN THOSE WITH A SPECIAL SEX INTEREST

Problem No.	Rank	Main words
1	2	3
10	10	Purifying water
18	10	Clothing stains
95	10	Best antiseptic
20	9	Difference between wool, silk, and rayon
27	9	Paint remover
46	9	Rapid growth nutrients
96	9	Mouth wash or gargle
9	8	Water and plant growth
54	8	Value of raw fruits
55	8	Value of well cooked meats
58	8	Disinfectants
97	8	Tooth pastes

TABLE II

MAIN WORDS OF LOW RANKING PROBLEMS OTHER THAN THOSE WITH A SPECIAL SEX INTEREST

Problem No.	Rank	Main words
1	2	3
3	2	Coke and charcoal fires
5	2	Artificial gas
25	2	Manufacture of varnish
26	2	Manufacture of shellac
49	2	Choosing edible fats
93	2	Hardening of plaster
19	1	Manufacture of rayon
40	1	Hair dyes
66	1	Smallest particles of matter
71	1	Meaning of alloy
73	1	Formula for water
74	1	Formula for table salt
85	1	Number of elements
89	1	Making slaked lime

on consumer studies. While the students gave the highest rank to a study of the efficacy of various cleaning agents upon different clothing stains, they put the problem involving a study of hair dyes in the lowest category along with hair oil and edible fats.

It may therefore be stated that regardless of the field of chemistry presented to students of junior high school age, if it is to deal with his felt needs and desires, it should be connected with something which is important to that student as an individual who is concerned with his own well-being.

SUMMARY

According to the results of this study given under the conditions described above, the following conclusions seem justified:

(1) The needs of the seventh grade students are sufficiently like those of the eighth and ninth grade students to consider that their chemistry needs are practically the same as for the two higher grades. It may therefore be concluded that the seventh grade students could profit by a course which dealt with those needs instead of waiting until the eighth grade for their first formal science course.

(2) There is little difference in the felt needs and desires of students coming from homes whose parents have different occupations.

(3) There is little difference in the felt needs and desires of dull pupils and advanced pupils in the junior high school.

(4) There are some problems involving a fundamental knowledge of chemistry which fill a much greater need in the lives of one sex than in the other. The number of such problems in the field of chemistry seems to be rather equally distributed between the sexes at the junior high school level.

(5) Consumer education has a reasonable limit in serving the felt needs and desires of students of the ages and grades of this study and can easily be over emphasized. This type of study is of most value when it deals with those materials which find the most frequent use in the lives of the students concerned.

RECOMMENDATIONS FOR FURTHER RESEARCH

In view of the limitations of this investigation and the additional problems which it brought out, the following studies should be made in order to arrive at more positive conclusions:

(1) The investigations should be carried into grades 10, 11, and 12 to see if the ratings of the questions are changed materially by further learning and experiences on the part of the student and to discover the reasons for those changes so that we can help prepare our junior high school students for needs that will presently confront him.

(2) This study should be repeated in localities with different basic occupations to test conclusion number 2, stated above.

(3) This investigation should be carried to all six grades with other lists of problems so as to more completely cover the field of chemistry.

(4) All of the most important problematic life situations thus found should be analyzed to determine the basic chemistry principles and generalizations needed to understand them.

(5) These four steps should then be repeated for all of the various fields of science.

(6) The most important problematic life situations involving a knowledge of the sciences and the various principles necessary to interpret and understand them should then be taken as a foundation upon which to construct a junior high school general science course which will meet the felt needs and desires of these students as well as help to prepare them for their rather immediate future.

BIOLOGY AS A CAREER

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The purpose of this study was to make available to students interested in positions in the field of biology information concerning requirements, salaries, and possibility of employment in the field of biology.

The subject of biology is so broad that the beginning student may well find it confusing. Most elementary courses in biology in the colleges and universities of the United States are so arranged as to acquaint the student with general principles and help him find the field in which he is likely to be most interested. A few students will, in the course of their studies, come across some question which they find they have an irresistible urge to answer to their own satisfaction. For these few, no guide to a life work is necessary. The majority of biology students, like the majority of students in any field, want a career in which they can find a deep personal satisfaction and can contribute a real service, and, at the same time, expect reasonable advancement and a salary sufficient to provide the necessities and comforts of life. It was in an attempt to point out to this group of students the opportunities in the field of biology that this study was undertaken.

All available literature was checked for information concerning positions in the field of biology. The information available was so meager that it was evident a more direct approach to the question was necessary. Since the professors who train the students in the various fields of biology are in a position to know both the types of positions available and the eductional and personal requirements of the positions, it was determined to send a questionnaire to biology professors in colleges and universities in the United States. The questionnaire asked for information concerning positions in the field of biology filled by students during the past five years. Information concerning special training, special requirements, the demand for workers in the field, the salaries paid beginners, and chances for promotion was requested.

Over two hundred questionnaires were returned. In addition to the information asked for, many of the respondees wrote interesting letters or added notes to the questionnaire. The head of the biology department at a state university in the Northwest remarked that his reply was not typical, as the politicians prevented him doing extensive work in science. A professor in a northern university listed marriage as the most popular career with his women students; the demand was listed as excellent, and the salary was left blank. A professor in the deep South stated the majority of his students ended as attendants at gaso-

line filling stations; while a lady professor in an eastern college for women replied that she could see point to the study.

Several professors sent literature concerning the various phases of biology training which they thought might prove helpful. Among these were:

Adams, Eugene, and Julius Miller. *Occupations in Plant Pathology.* Athens, Georgia: The University of Georgia College of Agriculture, 1938.

Possible Fields in Professional Service in Public Health, Industrial Biology, and Public Health Engineering. Cambridge, Mass.: Massachusetts Institute of Technology.

Proctor, Bernard E. *How Food Technologists Are Made.* Cambridge, Mass.: Massachusetts Institute of Technology, 1937.

Wrenn, C. G. *University Training and Vocational Outlets.* Palo Alto, Calif.: Stanford University, 1935.

Sherman, Edwin A. *Forestry as a Profession.* Washington, D. C.: U. S. Forest Service, 1936.

Careers in Forestry. U. S. Department of Agriculture. Miscellaneous Publication No. 249. Washington, D. C.

Wadsworth, Augustus B. *Opportunities for Training Offered by Division of Laboratories and Research.* New York State Department of Health, Albany, N. Y.

Outlines of Curricula in Applied Biology. Outlines of courses preparatory to careers in: Biology and Public Welfare, Industrial Biology, Laboratory Technology, Biology and Public Health. The University of Oklahoma, Norman, Okla., 1938.

Each of these discussions is complete and would prove helpful to anyone interested in a career in the field of biology. All are free, with the one exception of *University Training and Vocational Outlets,* the price of which is twenty-five cents.

The information concerning positions in the field of biology gathered from the replies to the questionnaires revealed various opportunities to exist for positions in this field. These opportunities are given under various headings.

TEACHING BIOLOGY

By far the greatest demand for people trained in the field of biology is for high-school biology teachers, especially when biology is combined with other science subjects. The chances for placement were given as poor to good. The salaries listed showed considerable variation, ranging from $800 per year to $3,700 per year. In general, salaries in the North are higher than those in the South. The maximum salaries listed are those paid in the large cities. It was also shown that where salaries are higher the standards for teachers are higher, a Master of Arts degree being almost essential to securing a position.

All high-school teachers must meet the requirements for certification in the state in which they teach. These requirements vary greatly. It would be well for anyone planning to teach to consult the requirements for certification for all states in which he might wish to be certified. It was noted that the requirements for certification of high-school biology teachers, in most states, are far below the standard for high-school biology teachers as set up by the professors of biology in the colleges and universities.

The demand for instructors in the various fields of biology in colleges and universities is shown to vary from fair to constant. Salaries are listed from $1,500 to $2,000 per year for beginners. In practically all cases a Master of Arts or Master of Science degree is essential, and a Doctor of Philosophy degree is desirable. Assistant professors, whose salaries usually range from $2,000 to $3,500 per year generally serve as promoted instructors for a period. A Doctor of Philosophy degree, with from three to six years of graduate work in the field of specialization, is necessary. Professors are usually promoted from the ranks of assistant professors. The maximum salary listed for professors was $10,000 per year.

The requirements for teachers of all

branches of biology in colleges and universities are much higher than those for high-school teachers. A liberal education, a broad knowledge of the facts essential to an understanding of the more significant principles and theories, abundant experience in laboratory techniques, ability to make ready and effective use of scientific literature and bibliographic materials, the capacity for careful and precise observation, the ability to judiciously interpret and to correlate data, and a certain boldness mixed with reasonable caution in generalization, were all given as prerequisites for a successful college instructor.

Closely related and often preparatory to teaching are fellowships and positions as research assistants. The demand for research assistants was listed as from fair to good. At least one degree is required. Further requirements vary, depending upon whether the research is under close supervision or independent. Positions pay from $750 to $3,500 yearly. At the lower figure there is quite likely to be some opportunity for further study. Secretarial, artistic, or technical training, as well as a sound knowledge of general biology are often essential. Fellowships offer opportunity for graduate study. The average pay is from $300 to $1,000 per year, plus tuition. A bachelor of Science degree and a sound knowledge of biology and chemistry are essential.

UNITED STATES CIVIL SERVICE POSITIONS

An attractive source of employment for one trained in the field of biology is with the United States Government. Positions have the three-fold advantage of being permanent, of offering opportunity for advancement, and of providing for retirement. The high-grade scientific and administrative positions are filled, when possible, by promotion. For this reason, it would be well for a young man or woman to apply for a position in the lower salary scale. When positions cannot be filled by promotion so-called unassembled examinations are given. Examinations for positions in the junior group have been given twice within the past five years. Positions in the junior group pay from $2,000 yearly up. Complete information may be secured from the Civil Service Commission, Washington, D. C.

STATE, COUNTY, AND CITY GOVERNMENT POSITIONS

The state, county, and city governments offer many positions in the field of biology. These positions are more and more being placed under civil service. The trend is definitely away from the political appointee and toward the appointment of trained people in all branches of government work, and especially in those branches which deal with such vital matters as conserving the health of the people and the resources of the country. State, county, or city Departments of Agriculture, Departments of Veterinary Science and Inspection, Departments of Fisheries, Departments of Biological Surveys, Departments of Public Health, and Departments of Forestry and Conservation all offer employment to persons trained in the biological sciences. Salaries and requirements vary with the location.

TECHNICIANS IN HOSPITALS AND PHYSICIAN'S OFFICES

The positions of technician in hospitals and physician's offices was reported as being especially good for women. Salaries listed range from $720 per year to $2,400 per year. The requirements for a hospital laboratory technician are set forth by the American Medical Association. A number of hospitals and medical schools offer the necessary training.

MISCELLANEOUS POSITIONS

A limited number of people trained in the field of biology have found employment during the past five years in various fields.

Bacteriologists are needed in brewing and distilling companies. The demand is good at the present time. The pay is about $200 a month.

Meat packers, food companies, dairy companies, and commercial biological laboratories all employ bacteriologists. Salaries range up to $5,000 per year. In these, as in most lines of biological work, the amount of graduate work greatly influences the opportunity for a position and the remuneration.

Botanical illustrators are in demand. Of these are required a knowledge of systemic botany and a special aptitude for the work. The salary is from $75 to $100 a month.

Commercial agriculture offers positions paying from $1,200 to $2,000 yearly. At least a Bachelor of Science degree is required. Agriculture training schools offer training for this type of work. Plant pathologists are employed by some truck crop growers.

Commercial zoologists are employed by the biological supply houses. A master of Science degree is almost essential. Salaries range from $1,200 to $2,400 yearly.

Erosion engineers are employed by the state and federal governments. This field requires a knowledge of botany combined with a knowledge of civil engineering. At present practically all of those employed are civil engineers who have a knowledge of botany.

Botanists are employed by some commercial florists. Salaries average $50 to $100 a month.

Research laboratories employ people trained in zoology. Salaries range from $1,800 to $2,500 a year.

Nature study Directors are employed by numerous summer camps. These positions pay from $10 to $25 per week, plus living expenses.

Zoos and museums employ people trained in zoology.

It will be readily seen that the field of biology offers a variety of positions for those who wish to consider biology as a career. The monetary reward offered by these positions is not enough to attract those whose purpose in life is to accumulate wealth. But for those who wish a career in the field of biology there are numerous opportunities for advancement. For those who wish security, the positions under civil service with state or federal governments are most attractive. The most easily entered field is that of high-school teaching. For those who possess real initiative the positions with research organizations will prove more attractive.

In all fields of biological work thorough general training is necessary before specialization is begun. The chances for a position and the amount of the salary is, in nearly every case, determined by the amount of graduate work in the field of specialization.

A STUDY OF THE CONSIDERATION GIVEN COLOR IN ELEMENTARY SCIENCE PROGRAMS

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Important factors of this study involve consideration of the status of the teaching of color in elementary schools, the development of significant and appropriate experiences for elementary school use, and the making of recommendations based on the study to the end that these may be adopted for use in elementary science programs and in literature.

Color as taught in Art, draws upon Nature for its forms of expression and often these forms are scientifically incorrect, even when no attempt is made at conventional design. This study has its origin in a comparison of apparent and actual color, where color is taught in Science, as a problem in a unit on Light.

This is not a study in Physics. Consideration has been given to the study of color only in the early years of the educational system, including the Kindergarten and the first six grades. The suggested studies and activities have been kept within the possibilities of the undeveloped rural elementary schools and therefore involve no elaborate facilities or equipment.

The study of color in elementary schools seems to have been limited to courses in Art, with few exceptions. In elementary schools where the study of color has been given consideration in the outline for Science, the study seems to have been so limited in scope and so superficial as to render it impractical for general use, application, or appreciation.

Through systematic consideration of Light in elementary school programs, through a study of the causes of color, the aspects of color, and the human visual limitations of color conception, it is suggested that color-mindedness could be established with a scientific basis for universal enjoyment of the commonplace. Since sight is aided by color in such instances as distinguishing distant objects, distinguishing otherwise similar objects, or in identification of specific characteristics of objects, the extent of the handicap suffered by color-blind individuals cannot be fully realized by individuals with normal eye-sight.

Because of the fact that so few attempts have been made at color standardization, and that there now exists no easily available universally standard color identification code, various industrial projects have attempted to define color scales for their own purposes. Trade and fad names have disrupted color conceptions. Scientific developments have multiplied color possibilities in commerce and in art. Artificial illumination has changed our color world. The art of mobile color has created a field for color form and color contrasts with limitless possibilities. Colors have come to be intangible concepts, yet their use concerns all individuals, in all phases of living.

Color as taught in Art programs is inadequate and inaccurate. Very few elementary school outlines include color study in Science programs. Most elementary science texts treat color in a superficial manner. Color study experimentation indicates that training of the child is a factor in the ability of the child in color discrimination. Visual limitations of the elementary school child can be discerned through more adequate examination, and can be corrected through child guidance programs. There is need for a practicable, inexpensive, and easily accessible color standardization.

A review of some elementary school programs in nature study and science from

different sources seems to indicate that only a few of the larger city school systems include color study in elementary science education. These build up a definite progressive color study through the grades. Others include an incidental study of color.

Of the science texts reviewed, there are two outstanding contributions for definitely constructive aid to color study for elementary schools.

Activities and problems are suggested, which have been used successfully with rural elementary school children and have been found to be suitable for color study in an elementary school science program.

Experiments were performed with different materials and different colors of the same material, placed on a fresh fall of snow during a day of 100 per cent sunshine, to determine the relative insolation transfer abilities of different colors, by measuring the depth of snow melted by each color of each material. This experiment was performed for the purpose of comparing the accepted concepts of WARM and COOL colors as taught in Art courses of study, with actual temperature influences of sunlight on different materials and on different colors of the same material. The experimental results indicate that yellow, red, and orange,—considered in art programs as warm colors,—transferred a smaller amount of heat from the sun to the snow, than the green, blue, and violet, which art considers as cool colors. If a child learns in science programs that a blue gas flame is hotter than a yellow gas flame, and if he learns in health programs that the blue end of the humanly visible spectrum causes our painful sunburns, the concept of "warm colors" in art education is cause for confusion and disillusion. Simple experimentation on the part of the elementary school child, besides his own experience with dark-colored clothing for protection against winter's cold compared with light-colored clothing for protection against summer's heat, will seem to disprove the concepts which art education would teach regarding warm and cool colors.

An experiment was performed with equipment of no cost, using living plants as subjects which might be found in any community, to ascertain the color range of twigs within one species during the winter months. It would seem from the results of this experiment that during the rest period, color changes in twigs of the six species studied, namely, *Acer pennsylvanicum, Acer Negundo, Salix fragilis, Salix alba vitellina, Cornus stolonifera, and Tilia americana,*—are not actual changes, but are apparent changes due to a combination of meteorological conditions and contrasts. A repetition of the experiment with different species of woody plants may show different results. Similar experiments can be carried on in rural elementary schools, using similar easily available material with wide range in color variation.

The conclusion is reached that there is a definite need for the teaching of color in the elementary school program. Color, as taught in Art programs, is inadequate and inaccurate. Color, as a phenomenon of light, places color teaching within the scope of the science programs. Color is being taught, at present, in comparatively very few science programs for the elementary schools of this country. Very few elementary science texts include constructive or adequate color study. Experiments, activities and problems in color have been worked out which are recommended as suitable to the needs of the elementary school child. There is a need for a more thorough test of the vision of the elementary school child, with guidance and recommendations for visual correction. Many color problems are encountered in everyday living. Color is a decided factor in the market values of commodities, which determine the economic status of different communities. There is a definite need for

an inexpensive color standardization in a practicable, easily accessible form for general use. As color words have come to be such intangible concepts, children's uses of color words would seem to the author to be meaningless unless a definitely progressive study is followed through the field of elementary science. The constant and inevitable "Why" of children of elementary school age, will be answered in regard to many of their experiences through such a program, and all color associations will come to be meaningful. No academic approach or consideration is necessary in order to guide the child along paths of study which are constructive.

PRINCIPLES OF ORGANIZATION FOR ORIENTATION IN BIOLOGICAL SCIENCE *

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In the selection of subject matter and in the formulation of a program of study for orientation in science, there should be definite guiding principles of organization. These principles should decide (among others) the following critical issues: First, what should be the major knowledge objectives? Second, what educational approach should be used to attain the objectives? In the case of biological science another peculiar issue is involved. Should the viewpoint be general or anthropocentric? That is to say, should all living things be considered as of equal importance, or should the focus of attention be directed toward man?

With reference to the first problem, the matter of major objectives, the *Thirty-first Yearbook, Part I*, of the National Society for the Study of Education, in summary says:

> The program of science teaching will be one which seeks to interpret the contributions of science to health, to safety, and to the development of the economic order; and it will be one which seeks to interpret the principles and generalizations that have largest application in effecting mental and emotional adjustment of the individual to the cosmos of which he is a part.[1]

In a study of the objectives of the science survey courses now extant it was found that ". . . the greatest concern is with the transmission . . . of the main generalizations of science.[2]

The literature dealing with the description of science orientation programs contains many clear-cut statements of the major aims. The following are examples. The objective is ". . . to aid the student in his orientation by presenting some of the fundamental principles of the science." [3] The students ". . . should concern themselves with general viewpoints and major understandings, instead of introductions to special subject-matter fields which they may never enter." [4] "The courses are intended to form part of a liberal education, they should present scientific method and biological principles, and enlarge the student's experience of the world about him." [5]

* This article is, in a real sense, a continuation of an article by the author in the October issue.

[1] National Society for the Study of Education. *Thirty-first Yearbook, Part I.* Bloomington: Public School Publishing Company, 1932. 370 p.

[2] Winokur, M. "Survey of Generalized Science Courses in Institutions of Higher Education." *Science Education* 20: 132–140; October, 1936.

[3] Norris, Will V. "Survey Courses of the Physical Sciences for College Freshman." *Journal of Chemical Education* 10: 631–634; October, 1933.

[4] Matherly, Walter J. "Comprehensive Courses." *Journal of Higher Education* 7: 124–133; March, 1936.

[5] Rickett, H. W. "Fundamental Biological Concepts." *Journal of Higher Education* 4: 67–70; February, 1933.

From these citations and others given in a previous paper it becomes fairly evident that the main knowledge objective of science education, as a part of general education, is the acquisition of the major generalizations of science, especially those of interpretative value. This constitutes what Downing calls "consumer science" as distinguished from the "producer science" of the researcher. He says, "Consumer science is not concerned with the whole field of any particular science but only with those few principles of it which are most often needed in solving the problems of everyday life." [6]

While there is fairly widespread consenses about the major objectives of science education, there is much less agreement as to how they are to be attained. Educators express considerable diversity of opinion with regard to the pedagogical procedure and the psychological approach that are most conducive to the development of scientific and interpretative generalizations. The committee that formulated the *Thirty-first Yearbook* holds that:

> Learning begins with the acquisition of the simplest learning elements. These impinge upon the nervous system in the form of simple sense perceptions. These simplest perceptions are the bases of conceptions and these in turn of generalizations. Conceptions and generalizations are, therefore, related hierarchies of simple learning elements. More mature learning involves association of these relatively simple hierarchies into more and more complex ones, and so the process of learning goes on. It is the aim of the school to provide the experiences which will make possible the most efficient growth in learning.[1]

The acquisition of generalizations, as described here, is essentially an inductive procedure, the construction of major ideas from minor contributory elements. In this view of the learning sequence, the understanding of the particulars must necessarily precede the comprehension of the generalization.

Careful distinction, however, must be made between elements that are logically prior and those that are psychologically antecedent.[7] The confusion between logical order and psychological sequence has led to an erroneous conception of the learning process. Logical hierarchies generally do not represent the actual order of learning. They in fact do not deal with temporal sequences at all. Logical order is concerned with the arrangement of evidence or proof. A phylogenetic tree or the "natural" classification of organism is an arraying of facts to provide evidence for organic evolution. But it by no means follows that the sequence from the primitive to the advanced is the order in which mankind or any individual man learned about the organisms. Nor does such a sequence *ipso facto* become the most effective and economical one for a learning program.

The order in learning on the other hand is a temporal sequence, different for each individual and conditioned by personal history. The temporal order in which one learns the characteristics of the vertebrates or those of the coelenterates depends on the circumstances of one's life. But this in no way affects the order of evolution or the relative complexity of the vertebrates and coelenterates.

The sequence in which a given individual learns a generalization or some of its pertinent particulars, is concerned with psychological and not logical derivation. It has been held, as indicated in the quotation above, that apprehension of the particulars must precede comprehension of the generalization. That is to say, a knowledge of the particular features of plants and animals is necessary before one can develop an understanding of the generalization called organic evolution. Still it is evident

[6] Downing, Elliot R. *An Introduction to the Teaching of Science.* Chicago: University of Chicago Press, 1934. 258 p.

[7] Cohen, Morris Raphael. *Reason and Nature.* New York: Harcourt, Brace and Company, 1928. 470 p.

that one may comprehend the idea of organic evolution without even being aware of the existence of Peripatus or of Ornithorhyncus. These particulars may be acquired subsequent to the generalization.

Furthermore, one is certainly not born with a store of facts or generalizations. While experience is necessary for the development of ideas, it is hardly a tenable view that a new-born infant synthesizes sense perceptions into concepts and then from these induces generalizations.[8] The very opposite sequence, in fact, is commonly observed. The baby becomes aware of the generality *man*, all examples of which are called dadda, before he is able to distinguish his particular father.

Furthermore no person formulates all of his generalizations. He lives in a society in which certain ideas are prevalent. Through the language and the mores of the society these ideas are conveyed to him. Subsequently he may or may not have occasion to test these ideas by individual experiences.

It therefore cannot be maintained that the perception of the particular must always precede comprehension of the universal. From the illustration given one might indeed argue the contrary. However what actually happens is that the universal idea and the particular instance develop in meaning together. The specific fact amplifies and gives substance to the idea, while the idea clarifies and lends significance to the fact.

Scrutiny of the historical development of knowledge, whether of the individual or of the group, reveals that the advance is not from the specific to the general but from the vague to the definite.[9] The vague perception with which learning begins is neither particular nor general. The distinction is merely implicit. It is only by analysis and abstraction that particularity or universality can be brought to the level of awareness.[10]

Another commonly offered basis for the insistence upon the inductive approach in the learning of scientific generalizations is the contention that it is the method by which the generalizations were actually formulated in the historical development of science itself—that induction is the method which the scientists themselves use. Careful scrutiny of the work of individual scientists reveals, however, that deduction plays an equally important role in scientific discovery.[11, 7] It is especially prominent in the work of such men as Albert Einstein, and J. Willard Gibbs. A notable instance of the use of induction in science is Einstein's prediction of the bending of light rays passing the sun.

From the psychological standpoint it is to be expected that certain ideas or generalizations must precede fact-finding efforts. This is especially true of ideas about the methods to be employed. Furthermore, carefully reasoned anticipatory ideas indicate where crucial observations are to be made. The scientist does not simply gaze at nature with a vacant stare and an empty mind. Contrary to Bacon, an investigator does not procede by tabulating indiscriminate observations and from them deducing a law.[7, 12] The working methods of scientists are not as elementary as that.

Scientific research is stimulated by contradictions between theories or between theories and observations. The great scientist is marked by the multiplicity of hypotheses, or logical anticipations, that he

[8] Wheeler, Raymond Holder. "Problems of Educational Reconstruction." *Educational Administration and Supervision* 21: 32–44; January, 1935.

[9] Ritchie, A. D. *Scientific Method.* New York: Harcourt, Brace and Company, 1923. 204 p.

[10] Wheeler, Raymond Holder. "Gestalt Psychology in Relation to Education." *California Journal of Secondary Education* 10: 32–44; October, 1935.

[11] Harding, T. Swann. "Humanism of Science." *Progressive Education* 8: 472–479; October, 1931.

[12] Lowenstein, Norman. "Inductive Fallacy in Science Teaching." *High Points* 16: 25–28; February, 1934.

can imagine that might resolve these contradictions. Such anticipations point to crucial experiments or observations that may test the validity of the alternative hypotheses. Those hypotheses that survive the test of experimentation constitute the generalizations or laws of science for the time being.

It is evident that the methods used by great scientists are of a very high order of difficulty, and only men of considerable intellectual prowess are capable of utilizing them. Individuals of only average mental ability cannot reasonably be expected to employ such advanced techniques for their independent discovery of knowledge. However, they can and should be given opportunity to appreciate the actual working procedures of great scientists. While ordinary mortals may not have the genius to cut their own paths along the frontiers of knowledge, many are capable of following once the roads are opened; and all can, to a greater or lesser degree, appreciate the skill, resourcefulness, and ingenuity with which the scientist applies the key of reason to unlock the secrets of nature.

It has been contended, nevertheless, that, since the laboratory has been the great fount from which science has sprung, real learning of science can come only from the same source. In actuality however, a student cannot possibly rediscover for himself every fact included in a science course. These facts are innumerable and the results of often intricate and elaborate experiments by master scientists. Yet it is felt that the student should learn the method by which these facts were originally determined. This aim is unquestionably a worthy one, but it by no means makes it either feasible or desirable to convert all of science learning into exercises in scientific methodology.[13] One phase should certainly be an acquaintance with and an appreciation of the methods utilized by great scientists. But since it is impossible to validate all knowledge by personal experience, most teaching might well be an inductive-deductive development aimed toward student apprehension of the great generalizations of science.

At any rate, by pragmatic standards, the focussing upon principles has proved the most desirable orientation of the science survey courses. It is the organization most commonly functioning in actual practice. In the literature of science education there are many descriptions of the satisfactory operation of courses constructed about the major ideas of science.[14, 15, 16, 17, 18] Such organization is in accord with the criticism, made by laymen and by educators, that instruction in science must be oriented toward the understanding of general principles and away from memoriter learning of scientific minutiæ.[19, 20, 21, 22, 23, 24, 25, 26]

[13] Freeman, Edward M. "Efforts to Reorganize Science Instruction in the University of Minnesota." *Peabody Journal of Education* 6: 204–218; June, 1936.

[14] Schlesinger, Herman I. "General Course in Physical Sciences in the University of Chicago." *Institute for Administrative Officers of Higher Institutions. Proceedings.* 75–83; 1931.

[15] Freeman, Ellis. "Two Types of Divisional Courses in the Natural Sciences." *Journal of Higher Education* 7: 308–312; June, 1936.

[16] Allen, John S. "An Introductory Course: the Physical Science Survey for Freshman at Colgate University." *Journal of Higher Education* 6: 410–414; November, 1935.

[17] Hunter, George W. *Science Teaching.* New York: American Book Company, 1934. 552 p.

[18] Orr, M. L. "Curriculum Revision at Alabama College." *Journal of Higher Education* 6: 179–184; April, 1935.

[19] Wood, George C. "The Science of Tomorrow." *High Points* 17: 31–34; December, 1935.

[20] Foerster, Norman. "Chicago and General Education." *American Review* 5: 404–419; September, 1935.

[21] Shumway, Waldo. "Survey Courses and the Junior College." *School and Society* 34: 207–214; August, 1931.

[22] Simons, J. H. "Fundamentals of Science." *School Science and Mathematics* 28: 966–978; December, 1928.

[23] Editorial. "Science Teaching for All." *London Times*, Educational Supplement 28: 441; December, 1936.

Despite the demonstrated success of survey courses constructed about generalizations, there has been raised the objection that such an organization lacks the necessary element of interest. Those actually engaged in the administration of these courses report however that their experience is to the contrary.[14] Students exhibit abundant interest in that kind of study which explains the nature of things. There is apparently considerable satisfaction derived from acquiring an understanding of the fundamental causes of natural phenomena.[1]

A further objection to the college science survey course has been made on the ground that it is an unnecessary duplication of the work of the high school. This attitude springs from a lack of understanding of the real contribution of the college survey course in the learning sequence. While apparently the high school and college courses overlap in subject-matter areas, from the viewpoint of the psychology of learning, they actually do not overlap but rather complement each other. In the high school science courses there are supplied the basic factual data and experiences, which, in the college survey course, are integrated into broad generalizations and mature understandings.[27, 28]

With respect to the physical science survey it is fairly generally agreed that the major orientation involved is the place of man in the physical universe. In the biological science survey there is no clear consensus. One might of course paraphrase and say the understanding sought is the place of man in the biological world. But the problem would still remain as to whether man were the chief object of attention or whether all of the living world were of equal concern, with man just part of it.

The most distinctive characteristic of modern biology is that it centers attention upon the activities and relationships of living things rather than upon their more static features.[29] The question at issue is whether the fundamental biological processes should be studied with man as the representative organism or whether examples should be drawn from any living things that best serve to illustrate the principles.

Progressive educators realize that the fundamental phenomena of life are common to all living things and are not limited solely to man. They hold that to study these phenomena in man alone would tend to establish in the student's mind an erroneous and unwholesome outlook on life. They therefore contend that the materials of the general biology course should be drawn from all living things, plant and animal, simple and complex.[30]

On the other hand, some practical administrators in experimenting with biology surveys have come to the conclusion that the orientation type of course should center attention on man.[31] At Colgate University, where a course of anthropocentric organization is in operation, a main reason ascribed for its success is ". . . the important discovery that the student is primarily

[24] Bless, Arthur A. "Aims of a College Course in Science." *Journal of Chemical Education* 9: 889–894; May, 1932.

[25] Hutchins, Robert M. "Analysis of the Issues in Higher Education." *International Journal of Ethics* 34: 56–63; January, 1934.

[26] Cullis, Winifred C. "Need for the Teaching of Biology." *School Science and Mathematics* 36: 74–81; January, 1936.

[27] Judd, Charles H. "Adopting the Curriculum to the Psychological Characteristics of the Junior College." *Institute for Administrative Officers of Higher Institutions. Proceedings.* 8–17; 1929.

[28] Caldwell, Otis W. "A Coherent Science Teaching Program." *National Education Association. Proceedings.* 441–442; 1935.

[29] Elftman, Herbert. "The Biological Sciences." *National Society of College Teachers of Education. Yearbook.* 43–59; 1937.

[30] Pieper, Charles J., Beauchamp, Wilber L., and Frank, Orlin D. *Everyday Problems in Biology.* New York: Scott, Foresman and Company, 1932. 686 p.

[31] Hibbard, Addison. "A Correlation Program at Northwestern." *Journal of Higher Education* 4: 24–26; January, 1933.

interested in the life process as it displays itself in his own species.[32]

Several biologists, of anthropologic leanings it must be admitted, also range themselves on the side favoring a course organized about man as the chief biological organism.[33, 34]

However, human biology does not necessarily have to be slighted in a course of general organization. A satisfactory compromise program can be worked out which will adhere to the fundamental philosophy that the processes of life are common to all living things and at the same time will give adequate attention to their operation in man.[35, 36]

In any given area of such a course, the problem of sequence arises. It is frequently contended that a survey of living things should start with the simplest and progress to the most complex, namely man. Logical as this order seems, it is in contradiction to the well-established psychological principle that learning progresses from known areas to unknown elements. It would therefore be preferable to begin with more familiar organisms and processes despite their higher position in the logical scale of complexity.[36, 37]

[32] Young, C. W., Stebbins, G. L. *The Organism and the World of Life.* Hamilton: Colgate University Press, 1934. 199 p.

[33] Hrdlicka, Ales. "Anthropology and Education." *Progressive Education* 8: 466–468; October, 1931.

[34] Pearl, Raymond. "Human Biology in Schools and Colleges." *School and Society* 42: 111–118; July, 1935.

[35] Guyer, Michael F. *Animal Biology.* New York: Harper and Brothers, 1931. 744 p.

[36] Huxley, Julian. "Biology a Cultural Subject." *New Era* 13: 3–4; January, 1932.

[37] Buchanan, James William. *Elements of Biology.* New York: Harper and Brothers, 1933. 478 p.

QUESTIONNAIRE RESULTS ON THE VALUE AND EXTENT OF THE FIELD TRIP IN GENERAL BIOLOGY

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Today field work is considered an essential technique in science instruction by nearly all authorities. A record of the early use of the organized field trip in the education of the youth occurs in Asch's *The Nazarene.*[1] In the pursuit of the biological and craft studies the young Hebrew was led into the fields by his teacher. An early modern advocacy of excursions into the field for general education is found in Rousseau's *Emile.*[2] Pestalozzi put this into practice in the first decade of the nineteenth century. Louis Aggassiz established on Penikese Island the first Summer Biology Laboratory for teachers.[4] Since that time, numerous biological stations have been established over the nation, while in current literature and in methods courses the importance of the field trip is stressed.

Little experimental evidence has been collected relative to the value of the field trip in biology. There are no published experiments on the college level. Schellhammer[5] conducted a simple rotation experiment in the Evander Childs High School, New York City. He concludes: "The field trip was successful as a device for increasing the learning process as measured in terms of pupil ratings."

[1] Asch, Sholem. *The Nazarene.* G. P. Putnam's sons, 1939. p. 427.

[2] Worthington, E. *Extracts from Rousseau's "Emile".* D. C. Heath and Co. p. 144.

[3] Bolton, S. K. *Famous Men of Science.* T. Y. Crowell Company. p. 195.

[4] Gould, A. B. *Louis Aggassiz.* Small Maynard and Company.

[5] Schellhammer, F. M. "The Field Trip in Biology". *School Science and Mathematics* 35: 170–173; February, 1935.

Tinkle,[6] desirous of knowing the present extent of field study, made an investigation into the high-school field work of students in Marshall College, Huntington, West Virginia. A questionnaire similar to the one presented below was given to 315 students. The results are given in Table I, together with the results of the present study.

The writer wished to learn, first, the present extent of field work in the high-school training of the students in elementary teacher training institutions of Oregon, and second, the value attached to field work by the students. In order to determine the present extent of the field work in the high-school training of college students, the questions submitted below were asked of 533 students in several teachers' colleges at different times. The questionnaire was given to fifty-one students at the beginning of the 1938 Spring quarter and to 228 students at the beginning of the 1938 and 1939 Fall quarters at the Eastern Oregon College of Education; to 186 students at the Oregon College of Education; and to 68 students at the inception of the 1939 Summer quarter at San Jose State College, California. These students were in beginning biological science courses.

The questionnaire included the following questions:

1. What was the size (average daily attendance) of your high school?
2. Did you have biology in high school?
3. Did you have any field trips in your high school biology?
4. How many such excursions did you have?
5. In your opinion, was the teacher adequately prepared for the field trip? Explain.

The student was not asked to give his name, the name of the high school, nor the name of the instructor.

An analysis of the tabulated data in Table I indicated that more than sixty per cent of the Oregon students had had high-school biology, and about forty per cent of the California students had. Both of these groups were surpassed by the West Virginia group by a significant difference. About forty per cent of the Oregon and California students had had field trips in their high-school course, while more than fifty per cent of the Marshall College students had had field work. The range in number of excursions was from one to six in the Western group, with an average number varying from 1.64–3.01. Marshall College's range was from one to twenty, with an average of 6.1. Most of the field work had been taken in schools with an average daily attendance of one hundred to five hundred. More than fifty per cent of the students in two groups who had field trips and who answered this question be-

TABLE I

QUESTIONNAIRE RESULTS ON THE PRESENT EXTENT OF FIELD WORK IN THE HIGH SCHOOL BIOLOGY OF COLLEGE STUDENTS

Responses	Marshall College West Virginia 1933	Colleges of Education			San Jose State College Summer 39
		Oregon Fall 38	Eastern Oregon Spring 38	Eastern Oregon Fall 38–9	
Number of student responses	315	186	51	228	68
Had high school biology	82.53%	69.89%	58.82%	66.66%	44.11%
No field trips in high school biology	48.07%	60.00%	80.00%	56.78%	63.47%
At least one field trip	51.93%	40.00%	20.00%	43.22%	36.63%
Range in number of field trips	1–20	1–6	1–6	1–6	1–5
Average number of field trips	6.1	1.64	2.69	2.48	3.01
Teachers adequately prepared	101	43	3	60	11
Teachers not adequately prepared	34	16	3	59	3

[6] Tinkle, Wm. J. "Field Trips in Biological Courses". *School Science and Mathematics* 33: 947–950; December, 1933.

lieved their instructors adequately prepared. About one fourth of the remaining three groups believed their instructors not adequately prepared. Explanations of inadequate preparations in student words included: "didn't know his stuff", "only interested in book work", "d.d nothing to vitalize the field trip". Table I shows these findings.

A second questionnaire study was made at the Eastern Oregon College of Education in 1938 and again in 1940 in order to determine the values of the field trip in college biology from the standpoint of the students. At this school, more than a third of the laboratory time was devoted to field work, most of which was done during the spring quarter. At the end of this quarter the questionnaire presented in Table II was given. The students' responses were tabulated and are presented in the table. All statements made by the students are included also.

It is evident from the data shown in Table II that teacher-training students like field trips and that they get definite values in the form of knowledge, techniques, and interests from them. These are the results that biology teachers seek to engender. This evidence, meager though it is, supports the contention that more field work is desirable.

Several generalizations may be drawn from the results of these investigations, inadequate as they are. First, the field trip in general biology is valuable. Student opinion corroborates that of science educators in this regard. Second, the present extent of field work in high school biology is low. Third, many students believe the teachers of high school biology are inadequately prepared for the field work. Both theory and practice dictate that more emphasis be placed on the field work in general biology.

This situation should constitute a challenge not only to the teachers of general biology, but to the teacher training institutions as well.

TABLE II

QUESTIONNAIRE RESULTS OF STUDENT OPINION ON VALUES OF FIELD TRIPS IN COLLEGE BIOLOGY

Questions	Responses	1938	1940	Remarks	1938	1940
1. Did you enjoy the field trip held during the course?	Yes	49	93	Enjoyed most of them		2
	No	2	11	Some mornings I did		1
2. Do you feel that they were worth while?	Yes	48	99	Some lacked purpose		1
	No	2	5	Part of them	1	
3. Do you prefer the field trip to indoor laboratory work?	Yes	44	96	In good weather		4
	No	7	8	Likes the change	1	
				More airy	1	
4. Do you think that you get more, or less, science knowledge from the field trip than from your indoor laboratory work?	More	32	66	More practical	3	10
	Less	10	34	More technical indoor, common outdoor	1	3
	Equal	5	4	One supplements other		7
				Too general		3
5. Do you think that the field trip contributes more, or less, to your interest in nature than the indoor laboratory work?	More	50	103	Improves understanding	1	
	Less	1	2	Never knew there was so much to know outside	1	
6. Do you think that the field trip gives you more, or less, than can be used in the prospective teaching situation than the indoor laboratory work?	More	43	98	Equal	3	
	Less	2	7	Didn't know	3	
				Need both		1

THE TRENDS IN THE SUBJECT MATTER OF HIGH SCHOOL CHEMISTRY

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The most significant factors that have influenced trends in high school chemistry are the objectives outlined by the American Chemical Society.[1] These objectives have indirectly influenced the authors of textbooks and have made the subject more interesting to the increasing number of pupils in the secondary schools.

The indications are that, in earlier days, colleges dominated the subject matter and caused it to become theoretical rather than practical. Under the influence of colleges, chemistry changed from a course of practical application to a course dealing with principles and theories. This theoretical material had little place in the secondary school that was to educate for practical purposes.[2]

The rapid increase in high school enrollment, however, focused public attention once more upon the secondary school, with the result that new aims were formulated. These new aims made college preparatory courses unsuitable for the high-school curriculum. The result was that the chemistry course for the high school contained actually very little material to aid the pupil in meeting his daily problems.[3]

The sources of data for this analysis were twenty-four chemistry textbooks that have been published and used in the secondary schools from 1900 to 1938. Four were chosen from the period 1900 to 1909, four from the period 1910 to 1919, eight from the period 1920 to 1929, and eight from the period 1930 to 1938. The scarcity of published textbooks in the earlier periods accounts for the distribution of selection.

The trends of new subject matter in these chemistry textbooks were determined by making an analysis of the chapter headings in each book. As new topics were introduced from year to year, they appeared as new chapter headings. The appearance of these new chapter headings would indicate the changes in the field of chemistry and at what time they occurred.

In the twenty-four chemistry texts there occurred one-hundred and twenty-three different chapter headings. Some of these topics were not found in a sufficient number of the texts and could not be used to show any new developments. Only those chapters that presented definite material connected with the chapter headings were used to demonstrate the actual trends.

Each book was carefully analyzed and the total number of pages in each book was divided by the number of pages in each chapter which gave the percentage of space occupied by that topic. This was done for all of the books, which were then separated into decades, according to their date of publication. The average percentage of space occupied by that topic during each decade was calculated and is shown in Table I.

The chapter headings concerning the different elements and related groups were gradually replaced by new topics. The amount of space allotted to these topics showed a sharp decrease, although the chapter headings concerning the atmosphere and the gaseous elements showed a

[1] Hopkins, B. S. "A National Standard Minimum Course in Chemistry." *School Science and Mathematics* 24: March, 1924.

[2] National Society for the Study of Education. *Thirty-First Yearbook*, Part I, "A Program for the Teaching of Science." Public School Publishing Company, 1932.

[3] Powers, S. R. *A Diagnostic Study of the Subject Matter of High School Chemistry.* Bureau of Publications, Teachers College, Columbia University, 1924.

relative consistency throughout the four decades.

The analysis of chapter headings revealed an increase of new topics, averaging about four per cent each year. The book published in 1900 possessed thirty-two chapter headings; ninety-seven distinctly new topics were added before the analysis was completed. This increase in number is the result of bringing new fields of science to the student's attention. Then too, the headings are changing in nature; the use of elements and compounds as titles is gradually disappearing, and in their place one finds practical and industrial processes.

The subject matter of the more recently published chemistry texts varied in content from those of the earlier periods. The contents revealed a shifting emphasis on the importance of some material found throughout the entire number of texts: while such topics as elements and compounds were considered earlier in the books, the discussion of chemistry in industry replaced these topics in the books of the later period. Topics that would be of significance to the teacher were included by some texts in the form of teaching aids, outlines, and practical problems. Some presented topics dealing with the chemistry found in the home and the place of chemistry in personal and public health. The evolution of laws, principles, and hypotheses in the forms of definitions undergoes different forms of treatment in the various texts over the four periods. As new discoveries in

TABLE I

ANALYSIS OF CHAPTER HEADINGS

Chapter Heading	Percentage of Space Occupied			
	1900–1909	1910–1919	1920–1929	1930–1938
Hydrogen	3.10	2.10	2.20	3.30
Oxygen	3.35	3.13	3.05	3.66
Water	4.30	3.40	3.50	3.40
Metals	0.80	2.80	3.30	6.10
Carbon and its compounds	5.19	4.90	2.84	2.80
Periodic System	2.20	1.74	2.10	2.00
Chlorine	3.15	2.40	2.41	2.63
Halogens	3.90	2.91	2.70	2.28
Silicon and its compounds	5.00	4.10	3.40	3.00
Molecular and atomic wts.	4.30	2.00	1.40	2.00
Copper, Silver, Gold	3.50	2.50	2.40	1.71
Flames and Illuminants	2.30	2.60	4.11	3.60
Acids, Bases, and Salts	2.90	0.65	1.91	1.50
Nitrogen and Atmosphere	2.60	1.82	1.67	0.95
Nitrogen, Acids, and Oxides	3.70	2.19	2.10	1.30
Solutions	1.20	1.21	2.00	1.21
Hydrochloric Acid	2.61	0.83	2.26	1.20
Aluminum	2.00	1.80	1.61	0.67
Phosphorous, Arsenic and Antimony	3.20	1.10	2.20	0.81
Ionization	0.00	1.20	1.80	2.60
Gases and Pressure	1.90	1.50	1.20	1.50
Magnesium and Chromium	2.20	1.60	1.20	0.20
Lead, Tin, and Platinum	2.10	1.80	1.60	0.20
Chemical Equations and Calculations	0.60	2.20	1.90	1.80
Valence	0.40	0.30	1.70	0.70
Radium and Radioactivity	0.00	0.60	1.90	2.20
Alkali Metals	3.20	1.40	1.20	0.75
Alkali Earth Metals	2.90	1.90	0.70	0.60
Zinc, Cadmium, Mercury	1.52	1.10	0.95	0.00
Iron, Nickel, Cobalt	1.55	0.95	0.40	0.00
Soaps, Solvents, Paint	0.00	0.90	1.10	1.20
Colloids	0.00	0.00	1.50	1.90

the field of chemistry were made, new names appeared in the texts, and some mention was made concerning the lives of these chemists, so that they might be of some inspiration to the pupils.

The trends of new subject matter relative to special features are listed in Table II.

The group classified as "Teaching Aids" is composed of topics for study chapter outlines, and summaries. If other similar aids were found without any title, they were placed in this group. With the exception of the second period, the four periods showed an increase in space devoted to this type of material. The increasing amount of knowledge in the field of chemistry would necessitate the assistance of the authors in giving all aids possible, both for the teacher and the pupil, for the complete mastery of the subject matter.

The group classified as "Definitions" is composed of laws, theories, and hypotheses. This topic indicates a mild but consistent decrease in the percentage of written space allotted them for the four periods.

"Elements and Compounds" usually occupied a greater part of the written space of each book but shows a steady decline in the average percentage of space from 63.59 to 31.17 per cent, which is about one-half as much written material in the last period as in the first period.

The group classified under "Industry" is composed of agriculture and all industrial manufacturing processes. This topic shows a consistent increase for the four periods, with only a minor deviation appearing in the third period.

The group classified under "Health" includes the study of medicinals, chemistry of foods, and unrelated physiological chemistry dealing directly with health conditions. This increase indicates that the chemistry of health is considered essential to a practical chemistry course in the secondary school.

The group classified under "Home" includes the physical relationships of chemistry to its simple home uses. In the second period chemistry in the home occupies an average percentage of space of 3.93 with a range from 1.57 to 9.25. This period includes the World War, which caused much home chemistry to be developed for sanitary purposes.

The amount of space devoted to "Biographies" includes all space devoted to portraying the lives of the more eminent chemists. The topic shows an increase which is consistent for the four periods and definitely indicates a trend in the textbook organization toward familiarizing the student with and stimulating him to learn more about the lives of our greater scientists.

The aims and their occurrence, as stated in the Prefaces of the books, are shown by Table III, which lists the books and their aims according to their period of occurrence.

TABLE II

TRENDS OF SUBJECT MATTER

Subject Matter	Percentage of Space Occupied			
	1900–1909	1910–1919	1920–1929	1930–1938
Teaching Aids	5.45	3.77	6.58	10.21
Definitions	9.62	8.61	8.33	8.16
Elements and Compounds	63.59	42.88	39.02	31.17
Industry	18.02	35.88	33.45	40.54
Health	0.00	3.99	5.44	6.42
Home	1.70	3.93	3.43	3.45
Biographies	0.62	0.76	1.43	2.89

"Scientific Attitude" was given as one of the aims but was found in the books under the following titles: development of scientific principles, scientific method, and scientific inquiry. This aim appeared once in the two periods from 1900–1909 and 1910–1919. It did not occur in the third period, but was found as an aim in three of the books analyzed in the fourth. This aim corresponds to the present aim of science in that a scientific attitude is essential to the study of chemistry.

"Teaching Chemistry" as a science is another aim but was found under the following varied titles: chemical point of view, principles of chemistry and knowledge of facts, college preparation, fundamentals, introduction of chemical phenomena, intelligible chemical theories, and chemical objectives. It shows a slight increase in popularity as an objective of chemistry. This phase of chemistry objectives is relatively important because it represents a homogeneous group of related objectives that are fundamental in the teaching of chemistry as a natural science.

"Principles of Teaching" as an objective is composed of specific directions, stimulation of interest, fundamental chemistry in nature and arts, social service of chemistry, provision of needs, interests and capacities, and psychology of learning. This aim increased in popularity more than did any other aim, because, as it has been pointed out before, teaching aids are being used more, and more stress is being laid upon the methods of teaching than ever before.

"Practical Chemistry" as an aim was determined from the group of aims such as principles applied to everyday life, teachable principles, non-technical chemistry, simplicity, applied and practical chemistry, presentation of chemistry for the layman, and chemistry in the home and industry.

TABLE III

Aims	Aims Stated in Prefaces			
	Period			
	1900–1909	1910–1919	1920–1929	1930–1938
Scientific Attiude	1	1	0	1
Teaching Chemistry as a Science	0	3	5	6
Principles of Teaching	1	0	3	7
Practical Chemistry	2	1	7	4
Mechanics of Structure	1	0	3	0

It has gained slightly in the estimation of authors in the four periods, but it is inconsistent in its gains.

The "Mechanics of Structure" is composed of scientific arrangement, clearness of statement, and clearness of subject matter. This aim is disappearing because the ability of the learner is determined better in modern books, and comprehensible material is usually found throughout the book.

The aims of chemistry as stated—scientific attitude, teaching of chemistry as a science, principles of teaching, practical chemistry, and mechanics of structure—have not changed to any appreciable extent, except those that deal with chemistry as a science and as part of the principles of teaching. Practical chemistry and mechanics of structure are not given as much emphasis in the present decade as in the last, while the aim of developing a scientific attitude is found in more of the later books than in the older texts.

A FUNCTIONAL COURSE IN SCIENCE

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THE PROBLEM

The practice in the teaching of general science has concerned itself, largely, with facts, principles, and generalizations, with the hope that the student would be able to apply such information to the understanding and controlling of his environment. This practice has brought meager results because of the mass of information presented and the lack of ability of the student to make application of facts to problems of his environment.

The purpose of this study was to develop a course in science which would reverse this teaching procedure. Rather than present a multitude of facts, principles, and generalizations, the purpose of the study was to set up definite problems of the individual. In the solution of these problems all facts, principles, and sources would be used. Thus, facts, rather than being merely accumulative, would have a definite bearing on some problem and would be used in its solution.

The course would conform to the principle of functional education, which is to make changes in the behavior of the individual. This would necessitate the setting up of problems which the child would solve. The problems must be those the individual needs to solve, thus, creating a tension which would activate one into doing or solving. In order that the problem may be brought to a solution, information would be needed, could be evaluated and organized. In the evaluation and organization of the information, thinking would be necessary, resulting in the acquisition of a fund of usable knowledge.

This study then was concerned with the selection of the problems of the individual in his daily living that need to be solved in order that he be a more happy being in the social order. The selected problems were to constitute the outline of the functional course in science.

If one accepts as the purpose of education that of making changes in the behavior of the child, the learning units used must be so designed as to involve something to be done by the child. These learning units would be selected from the life of the child. Since education is to make changes in the child's behavior, his own problem would be the basis upon which the changes could be made. With these problems expressed as something to be done or something to be decided and the fact that they are the individual's problem, a tension or wanting would be created which would activate the pupil to the procedure of doing or bring it to a solution. In doing, information would be needed, which would be evaluated and organized, resulting in the process of thinking. This thinking would lead to the building of a fund of useful knowledge. The final result would be the changes brought about in the behavior of the individual.

If the science program is to be functional for the pupil, more care must be used in the selection of the content of the course. Rather than present facts, principles, or generalizations the course should present problems. These problems must be selected from the life of the individual, so as to have meaning and create a desire for their solution. With the actual solution of these problems, information will be needed which may be drawn from the basic sciences. In this way, science facts will have purpose and meaning, thus being functional in the life of the individual.

THE TECHNIQUE OF THE STUDY

In the determination of the content of the functional course in science, a difficulty

analysis was made of (1) the activities in which a person engages in daily living, (2) textbooks in general science.

In the first, the analysis of the difficulties a person encounters in daily living, the problems one has to solve, which arise through his activities, were included because of their having the most vital effect upon the behavior of the individual. These problems may arise during work or play activities, as those concerned with the making of social adjustments, in fact, all problems that have a direct bearing on the individual's felt needs.

For the second source of problems, a difficulty analysis was made of the content of textbooks in general science. Since the subject matter of many of these books has been obtained by surveys of various kinds to ascertain the items of most importance and interest to children and adults, many problems of the individual would be indicated from the content of these books.

Twenty-six books, which ranged in data from 1927 to 1936 and represented a variety in authorship and type of content, were analyzed.

In the listing of the difficulties, they were expressed with the wording, "How to do." This represented the most functional type of expression, being next in order to the actual doing. In order to keep the problems or difficulties within the functional status of the individual, they were tested by the expression, Just what does the individual have to do about this?

In order to facilitate the handling of the difficulties, they were written on slips of paper, known at the University of Southern California, as Crawford's slips. With only one difficulty on a slip and each difficulty written at the top of the long side, the sorting into the respective classifications was greatly aided.

After the difficulty analysis of the activities of the individual and content of the textbooks was completed, some method of grouping the problems into related divisions was necessary. In order to keep these divisions on a functional basis, the main types of activities with which man is concerned were suggested. These are his home, his health, the consumption of goods, the use of tools, machines, and equipment, the use of plants and animals, his occupation, his play, and his social contacts.

From these major activities of man, were built the units of learning into which the difficulties were classified. The most functional way of expressing the unit was used. The resulting units were: (1) "How to improve home and family life," (2) "How to improve health," (3) "How to consume goods," (4) "How to use tools, machines, and equipment," (5) "How to use plants and animals," (6) "How to earn a living," (7) "How to play and use leisure time," (8) "How to improve social relations."

When the classification of the difficulties into the eight divisions was completed, it was found that none fell into the division of "How to earn a living." For that reason, it was omitted from the list, with the hope that some field other than science would give it attention.

The problems within each unit were then arranged in outline form, which is illustrated by the following unit.

OUTLINE OF HOW TO IMPROVE HEALTH

Probably of second importance to the individual is the maintenance of a healthy body. In order that health education be functional to a person, problems of health must be the basis of the study. With the solution of these problems, the individual should have a definite understanding of the care of his body, and that the health of his body depends definitely on his use and treatment of it.

I. How to care for the body
  1. How to care for the skin
    a. How to bathe the skin
      (1) How to select soap
      (2) How to determine whether to use hot or cold water

(3) How to select bath salts
b. How to use skin lotions
c. How to use cosmetics
d. How to use deodorants
e. How to prevent wrinkles
f. How to prevent skin eruptions
g. How to remove hair
2. How to care for the hair
a. How to wash the hair
(1) How to prevent dandruff
(2) How to remove dandruff
(3) How to select soap or shampoo
b. How to treat dry scalp
c. How to treat oily scalp
d. How to prevent falling hair
e. How to brush the hair
f. How to curl the hair
3. How to care for the nails
a. How to trim the nails
b. How to prevent hangnails
4. How to care for the teeth
a. How to brush the teeth
(1) How to select a brush
(2) How to select a dentifrice
b. How to prevent or check decay of the teeth
c. How to prevent pyorrhea
d. How to prevent acid-mouth
e. How to select a mouth wash
5. How to care for the eyes
a. How to prevent eye strain
b. How to select and use an eye wash
c. How to prevent sties
d. How to prevent pink-eye
e. How to determine if you need glasses
(1) How to treat for far-sightedness
(2) How to treat for near-sightedness
(3) How to treat for astigmatism
f. How to determine if plain glass were used instead of lenses in the glasses
6. How to care for the ear
a. How to test your hearing
b. How to improve hearing
c. How to select a device to aid hearing
d. How to prevent infections of the ear
e. How to protect the ear against loud noises
f. How to prevent earache
g. How to remove foreign objects from the ear
h. How to remove wax from the ear
7. How to care for the nose
a. How to blow the nose
b. How to relieve congestion of the nose
8. How to care for the throat
a. How to select a gargle
b. How to gargle
c. How to prevent throat congestion
9. How to breathe properly
10. How to care for the feet
a. How to prevent fallen arches
b. How to select shoes
(1) for comfort
(2) for correct posture
c. How to prevent 'athlete's foot'
d. How to prevent corns and bunions
e. How to relieve tired, aching feet
11. How to get good posture
a. How to stand
b. How to walk
c. How to sit
d. How to lie
e. How to lift heavy objects without damage to posture

II. How to "tone" the body
1. How to exercise
2. How to rest
a. How to sleep
b. How to relax during the day
3. How to prevent nervous breakdown
4. How to prevent heart failure
5. How to get sufficient sunlight
6. How to get a 'sun' bath

III. How to eat
1. How to chew foods
2. How to select foods
3. How to prepare foods for use
4. How to select a well-balanced diet
a. How to prevent constipation
b. How to prevent deficiency diseases
5. How to prepare a diet for losing weight
6. How to prepare a diet for gaining weight
7. How to prevent over-eating
8. How to prevent indigestion
9. How to aid digestion

IV. How to drink
1. How to select source of water
2. How to use water at meal-time
3. How to recognize good water

V. How to clothe the body
1. How to select color of clothing
a. for complexion
b. for season
2. How to select clothing
a. to keep warm on a cold day
b. to keep cool on a hot day

VI. How to protect the body against diseases
1. How to prevent the common cold
2. How to prevent influenza
3. How to prevent pneumonia
4. How to prevent diphtheria
5. How to prevent whooping cough
6. How to prevent scarlet fever
7. How to prevent measles
8. How to prevent typhoid fever
9. How to prevent smallpox
10. How to prevent tuberculosis
11. How to prevent glandular diseases
a. How to prevent abnormal growth
b. How to prevent diabetes
c. How to prevent goiter

VII. How to avoid the use of habit forming drugs
1. How to avoid the use of tobacco
2. How to avoid the use of alcohol
3. How to avoid the use of coffee
4. How to avoid patent medicines

INDUSTRIAL CHEMISTRY FOR METAL WORKERS

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Most courses in industrial education, organized under the Smith-Hughes act, include a subject known as "related science." The industrial course at Central High School, Lansing, Michigan, gives, as a part of the related science work, a year of industrial chemistry. The content of such a course which would be functional in the work of beginners in the metal-working industries of Lansing had never been determined, nor was there sufficient agreement among the authors of chemistry texts to make a textbook the basis for such a course of study.

The present investigation was made in order to determine what topics should be included in a course in industrial chemistry for prospective machinists and draftsmen at Central High School, Lansing, Michigan. This study was based upon an analysis of the demands made for chemical information in the jobs held by graduates of these courses during their first three years of employment in the metal-working industries of Lansing. The purpose of the investigation was to indicate changes and improvements in the present course of study in industrial chemistry in order to make it of greater value to future graduates.

To secure the necessary data, fifty graduates of the industrial course, employed in the metal-working plants of Lansing, were surveyed by means of a questionnaire, as to the jobs they held, the materials they used, and the operations performed on these materials. Twenty-seven foremen of departments, typical of the industries in Lansing, were interviewed as to the kinds of work done by young workers in their departments. The foremen were also questioned concerning the difficulties of a chemical nature arising in connection with the jobs of beginners. Shop manuals and high school machine shop texts were examined in order to verify the opinions of foremen. Factory managers and metallurgists were consulted as to the causes and remedies for the difficulties found; these were then analyzed for the chemical facts involved. Other chemical facts needed as background for a complete understanding of the chemistry involved in the causes and remedies for difficulties were added, and the whole was classified and organized into a teaching sequence. This was submitted for criticisms to other related subjects teachers in Michigan.

The study indicates that beginners in the metal-working industries of Lansing commonly use cold rolled steel, cast iron, solder, cutting compound, lubricating oil, tool steel, brass, bronze, alloy steel, acetylene, and oxygen. The operations which they most frequently perform are: soldering, hardening and tempering tools, welding, heat treating steel, and pickling. Twenty-six difficulties of a chemical nature occur in performing these operations. The chemical facts relating to these difficulties can be grouped as follows: facts relating to iron and steel; the properties of aluminum, brass, bronze and solder; oxidation and reduction processes; welding equipment and welding gases; acids and alkalies; electro-chemical reactions; solvents for oils and greases. Two of these topics are adequately covered in a previously given course in chemistry. The remaining five were included in the present course in related chemistry, the major divisions of which, as finally organized, are:

1. A general survey of metals; aluminum, copper, iron, and their alloys, particularly those used in Lansing industries.

2. The selection and testing of steels, especially tool steels.
3. The heat treatment of steel.
4. Solder and brazing materials and methods.
5. Welding materials and operations.

The study shows a definite need for chemical information on the part of young workers. The necessary facts relate to but few topics but considerable detail is required in developing each. An adequate background adds to the young man's worth by giving him an appreciation and understanding of the relationship of his job to that of those preceding and following him.

THE PUBLIC ADDRESS SYSTEM OF THE JOHN BARTRAM HIGH SCHOOL OF PHILADELPHIA *

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and
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Head of the Commerce Department

One of the new features of many high schools of recent construction is the provision for a Public Address System. Eventually, it is probable that all schools will be so equipped. The John Bartram High School of the city of Philadelphia is fortunate in the possession of such a system. This has been possible through the cooperation of the Board of Public Education, the student body, and friends of the school.

In the original construction contract, the building was "piped" throughout with conduits for the running of the wires of a public address system, and all classrooms were provided with the necessary outlets for loud speakers. After the building was opened, the Board of Education agreed to furnish and install the wires to interconnect the various rooms of the school with the public address system, provided the school bought the loud speakers and other equipment.

The equipment—consisting of the control panel, microphones, loud speakers, amplifiers, reproducing units, etc.—was purchased by the school, and is being paid for by contributions from the community, members of the faculty, and the student body. By far the largest proportion will come from the students, most of whom have pledged to contribute one dollar on a penny-a-day plan.

All rooms in the school have been connected to the system, including the Auditorium which may broadcast its programs to every room in the building, the Gymnasiums which are frequently used for dancing, the Recreation Hall which may be furnished with music for student functions, and the Lunch Room which may be supplied with a musical background during the lunch periods. The Recreation Hall and the Gymnasiums, because of their frequent uses for extra-curricular activities, are supplied with additional amplification. In all, about 80 classrooms, shops, and laboratories are supplied with the full facilities provided by this system.

For special occasions, such as plays, the Auditorium is provided with three microphones which may be operated either from the control desk or by a remote control mixer installed in the auditorium itself. The center microphone is a undirectional type mounted on a floor stand and is in constant use. For occasional use, two velocity-type microphones on floor stands

* *Editor's Note: This article was prepared at the suggestion of, and sent to us through the kindness of, William E. Burkard, Principal of the John Bartram High School.*

may be placed on either side of the stage to give wide range in pick up.

The master control desk is installed in a small room across the hall from the principal's office. This control desk houses two 12-tube radio sets and the automatic record player which is arranged to provide for the making of recordings of speech or music by a recorder. A microphone on a table stand may be plugged into the control desk, and thus the entire school may be addressed from the control room.

The uses to which the Public Address System has been put are too numerous to be detailed here. We may mention just a few:

1. Special announcements to school by the principal.
2. Tuning entire school to important programs presented in Auditorium.
3. Special radio broadcasts—speeches of the President, symphonic concerts, current news events, World Series games, etc.
4. Background music from the classics in classrooms before 9 o'clock.
5. Use of records as teaching devices, especially in Social Studies, English, and Music.

The Public Address System is thoroughly integrated as a part of the school program and has proved itself most valuable from an educational point of view. But we have only scratched the surface of its possibilities. The R. C. A. is now cooperating with the Philadelphia school system in providing recordings of the best-type radio programs for use in the schools. In many other ways the potentialities of the system are being explored with a view to further extensions of its benefits to the boys and girls of this school.

Editorials and Educational News

SCIENCE EDUCATION AND THE DEMOCRATIC WAY OF LIFE

Science is primarily a method of seeking truth. In its quest for truth it is morally neutral and ideally honest. It is no respecter of race, creed nor faction as long as it is science. It drives toward its goal without emotion and without regard for the social or political consequences of its findings. This impartial truth seeking spirit of science causes dictator nations to fear it, and causes more democratic forms of government at times to circumvent it. This objective nature of science also induces well meaning individuals occasionally to make harsh statements concerning it. But science must forever continue in this way, for, any attempt on the part of vested interests or of constituted authority to restrict the freedom of science to pursue its impartial course would close the way to truth in a degree commensurate with the success of that attempt.

The spirit of science and the spirit of genuine democracy sprang from the same vintage, namely, the inherent urge of men to be free. These began to manifest themselves in human affairs at about the same time and have maintained a symbiotic partnership ever since. They must stand or fall together.

To safeguard this truth seeking spirit of science and to secure the benefits of its findings to all the people is to insure the perpetuity of the democratic way of life. In this endeavor science education has a part to play. Said Alexander Meiklejohn in his treatise on philosophy, "The more men accomplish the greater is their need for understanding what they are doing. And if this is true then the present time is one of very great need." Science education recognizes this need and definitely concerns itself with the social and moral consequences of the findings of science. It is concerned with promoting a wiser use of the power the method of science has delivered into our hands. Above all it seeks to induce an attitude of intellectual honesty in dealing with the problems that beset human society.

In practice, science education assumes as a working basis the following hypothesis: The disorders that infest the world at the present moment are traceable to the selfish and unwise management of the power that the method of science has delivered to a scientifically unprepared world. The technological mode of society that man has created through the method of science suddenly induced power exploitation of the world's resources. This has made it easy for individuals, groups of individuals and whole nations to disguise selfishness and to induce a unilateral flow of opportunity with subsequent social and economic crisis. We are now in the midst of such a crisis on a world scale.

Attempts to deal with these conditions in a democratic way can meet with but little success with a public that is untrained in the truth seeking method of science (the hand-maid of democracy). Likewise it can meet with little success in a public unaware of the basic interdependencies that actuate the world and a public that lacks an understanding of the forces that the method of science has revealed and rendered available to us.

Science education seeks, therefore, to assist in producing a generation of lay conservationists or lay directors of the power which science has made available; a generation with at least a layman's insight into the meaning of the forces that are constantly transforming and disturbing

our social and economic life so that democracy may cease to be frustrated through selfish and unwise use of that power.

We believe this can best be achieved by a continuous process of growth from early childhood. The child, as he goes from grade to grade, from year to year, through wise exposure to the meanings of his world, both his social world and the universe of natural forces and phenomena, should gradually, and without hurry, be led to discover the basically fundamental truths concerning life and the world in which life must reside.

These basic truths should help furnish him with the raw materials for straight thinking, for honest judgment, and for effective social action in his contemporary world.

G. V. BRUCE,
State Teachers College,
Newark, New Jersey.

TWENTY-SECOND ANNUAL MEETING OF THE NATIONAL COUNCIL ON ELEMENTARY SCIENCE

ATLANTIC CITY, NEW JERSEY
February 22, 1941

Morning Session: 9:00–11:45
Stratosphere Room, Traymore Hotel
Jennie Hall, *President, Presiding*

The Contribution of Science to the Integrated Program of the Elementary School at Ohio State University.
Rose Lammel, Ohio State University

Developing the New Program of Conservation in Ohio.
O. E. Fink, Curriculum Supervisor, Conservation Education, State of Ohio

The Philosophy and Objectives of the National Council on Elementary Science.
Jennie Hall, Adviser in Science, Minneapolis, Minnesota

Discussion by Members.

Luncheon Session: 12:00 Noon
Joint luncheon with the National Association for Research in Science Teaching in the Belvedere Room, Traymore Hotel.

Afternoon Session: 1:30–3:45
Belvedere Room, Traymore Hotel
(Joint meeting of the National Council and the N.A.R.S.T.)

The Significance of Some Essentials of Accurate Thinking for Elementary Science Instruction.
George W. Haupt, State Teachers College, Glassboro, New Jersey

Children's Explanations of Natural Phenomena.
Mervin Oakes, Queens College, Flushing, New York

Business Meeting.

FOURTEENTH ANNUAL MEETING OF THE NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING

ATLANTIC CITY, NEW JERSEY
February 22–26, 1941

Saturday, February 22, 1941

Luncheon Meeting: 12:00 Noon
Belvedere Room, Traymore Hotel
Joint Luncheon with National Council on Elementary Science.

Afternoon Meeting: 1:30–3:45
Joint meeting with the N.C.E.S. (See program of N.C.E.S. above), to be followed by a television demonstration in the Auditorium, sponsored by the Department of Secondary Education of the N.E.A.

Sunday, February 23, 1941

Dinner Meeting Members Only
6:30 P. M.
West Room, Claridge Hotel
Harry A. Carpenter, *Presiding*

President's Address.

Business Meeting.

Report of Secretary-Treasurer, Ellsworth S. Obourn.
Report of Nominating Committee.
Election of Officers.
Report of Committee on Constitution's Revision, Otis W. Caldwell.
Report of Coordinating Committee, Francis D. Curtis.
Report of Publications Committee, Elwood D. Heiss.
Report of Committee on Time of Meeting, H. Emmet Brown.
Report of Curriculum Committee, A. N. Zechiel.
Report of Committee on Teacher Preparation, A. W. Hurd.
Other Committee Reports.

Monday, February 24, 1941

Morning Session

East Room, Hotel Claridge

Harry A. Carpenter, Presiding

9:00 Business Meeting.

10:00 Meeting of Area Committees.

12:15 Luncheon. Members are invited with the Department of Secondary Teachers of N.E.A. and Association of Technical High Schools and Institutes, Ambassador Hotel. *Speaker:* Harry Carpenter.

Afternoon Session

East Room, Hotel Claridge

G. P. Cahoon, *Presiding*

2:15 Needed Research in Science Education. A. N. Zechiel, Curriculum Consultant, Committee on Relation of Schools and Colleges, Progressive Education Association.

3:00 Panel on The Science Workshop: Its Purpose, Methods and Effectiveness.

W. C. Croxton, State Teachers College, St. Cloud, Minn.

J. Wallace Page, Director, Maryland, Academy of Sciences, Baltimore, Md.

A. O. Baker, Chairman, High School Science Curriculum Center, Cleveland, Ohio.

Clark W. Horton, Dartmouth College, Hanover, N. H.

E. A. Waters, University of Tennessee, Knoxville, Tenn.

O. S. Loud, Bureau of Educational Research in Science, Columbia University, New York City.

4:15 Discussion from the floor.

6:00 Dinner Meeting of Executive Committee.

5:00 to 10:00 Open time for Meetings of Area Committees.

Tuesday, February 25, 1941

Morning Session

Picadilly Room, Hotel Claridge

G. P. Cahoon, *Presiding*

9:00 Reports and recommendations by Chairmen of the Five Area Committees. Discussion led by the General Chairman, Francis D. Curtis.

10:00 Evaluation of Broadcasts and Recordings for the Classroom. J. R. Miles, Bureau of Educational Research, Ohio State University.

11:15 Discussion.

12:30 Luncheon (It is suggested that the area groups arrange to have luncheon together).

Afternoon Session

Solarium, Hotel Claridge

Harry A. Carpenter, *Presiding*

2:00 Experiences with a Junior Academy of Science. E. S. Obourn, John Burroughs School.

2:45 Discussion.

3:15 Reports from N.A.R.S.T. members on the National Science Committee. Led by Ira C. Davis.

4:00 Business Meeting.

6:30 Dinner. Suggest group dinners by the five Area Committees to consider procedures for the following year. Claridge Hotel.

Wednesday, February 26, 1941

Afternoon Session: 2:00–4:00

Room 125, Ambassador Hotel

N.A.R.S.T. members are invited to meet with the Department of Secondary Education of the N.E.A., whose program includes a showing of documentary films and a discussion of possibilities for using radio and television as aids to teaching. It is possible that further demonstrations of television will be available at this time.

THE HIGH SCHOOL SCIENCE LIBRARY FOR 1939-1940

The sixteenth annual list prepared by Hanor A. Webb was published in the November, 1940, issue of *The Peabody Journal of Education.* This list is now available in reprint form at the postpaid price of fifteen cents. The compiler describes the present list as follows:

> These titles will satisfy almost every desire for a type of enriched reading in science. Herein is practicality—much that will help in the intensive courses of mechanics, aviation, and other practical arts. Herein is drama; the adventure books this season are particularly thrilling. Herein is the poetry of nature, especially in gardens; herein is an unusual amount of fun in sports and games.

As in previous lists, the author gives his own suggestions for the purchase of reference books, grouping them in various price groups. Textbooks are paced in a separate list and carry no price groupings. The "library" represents one more valuable service to the teaching of science by the Editor of *Current Science.* All science teachers are indebted again to Mr. Webb.

FUNCTIONS DEFINED

Many of us have at times wondered concerning the definition of the respective functions of the United States Office of Education and the National Youth Administration. The November, 1940, issue of *School Life* carries a complete statement of agreement on these functions by the Federal Administrator of the National Youth Administration, The United States Commissioner of Education, and a group of chief State school officers and State directors of vocational education. Eight specific articles of agreement are stated in line with the clearly defined and mutually exclusive functions of the two agencies. Space does not permit our giving in full these statements. However, a general statement of principle is here quoted:

> Briefly, then, the function of the United States Office of Education is to secure the development and operation of educational or training programs for all youth, and the function of the National Youth Administration is to organize and administer programs of work for needy or selected youth.

ACTIVITIES IN EDUCATION AND RECREATION

The Works Projects Administration in Philadelphia has issued a report of its activities in education and recreation, sponsored by the Board of Public Education of Philadelphia. The report, entitled *For All the People,* describes the nature and variety of services rendered, the groups and the individuals who plan and carry out the activities, and the contribution to democracy of the program. The booklet is twenty-two pages in length.

Sections on "Science for the Layman," "Safety Education" and "Visual Education" will be of especial interest to science teachers.

Copies of the report are available and free, and may be had by writing to District Number 3, Works Project Administration of the Federal Works Agency, 232 North Eleventh Street, Philadelphia.

Enriching Science Teaching

Pupil Activities

Adventuring in Nature. By Betty Price. National Recreation Association, 315 Fourth Avenue, New York, N. Y. 1939. 98 p. 60 cents.

Conservation Excursions. U. S. Department of Interior, Office of Education Bulletin, 1939, No. 13. U. S. Office of Education, Washington, D. C. 1940. 106 p.

What to Make and How to Make It. By Popular Mechanics Staff. Popular Mechanics Press, 200 E. Ontario Street, Chicago, Illinois. 1940. 192 p. 50 cents.

Visual Aids

Du Pont Company, Motion Pictures Bureau, Wilmington, Delaware. 16 or 35 mm., sound and color. (Transportation charge)

A New World Through Chemistry

Eastman Teaching Films, Inc., Rochester, N. Y. 16 mm., silent films. (Purchase)

Fertilization—A Study Through the Microscope
Carbon-Oxygen Cycle
Nitrogen Cycle

Erpi Classroom Films, Inc., 35-11 35th Avenue, Long Island City, N. Y. 16 mm., sound films. (Purchase)

The Passenger Train
Elephants

Film City Pictures Company, Inc., Box 807, Hollywood, California. 16 mm., sound. (Purchase or rental)

Petroleum Geology

General Electric Company, Schenectady, N. Y. 16 and 35 mm., sound. (Free)

Early Experiments of Michael Faraday

The Asphalt Institute, 801 Second Avenue, New York, N. Y. 16 mm., sound. (Free)

Asphalt: Nature's Most Versatile Product

United States Department of Agriculture, Extension Division, in cooperation with the Bureau of Agricultural Economics, Washington, D. C. Obtainable from the Superintendent of Documents, Washington, D. C. Revisions of Educational Charts, 12 by 15 inches.

Corn (7 charts), 15 cents
Poultry Marketing (5 charts), 15 cents
Miscellaneous Fiber Plants (3 charts) 10 cents

Science Pamphlets and Bulletins

A. U. S. Government

Annual Report of the Petroleum and Natural Gas Division, Fiscal Year 1939. U. S. Department of Interior, Bureau of Mines. Report of Investigations 3501. Bureau of Mines, Washington, D. C. 1940. 41 p.

Conserving Farm Lands: Planning for Soil Erosion, Water Conservation, and Efficient Land Use. By Tom Dale and W. A. Ross. U. S. Office of Education, Vocational Division Bulletin No. 201, Agricultural Series No. 53 (1939). Superintendent of Documents, Washington, D. C. 1940. 104 p. 30 cents.

Currants and Gooseberries. U. S. Department of Agriculture, Farmers' Bulletin No. 1398. Superintendent of Documents, Washington, D. C. 1940. 38 p. 5 cents.

Factors Influencing the Use of Some Common Insecticide Dispersing Agents. U. S. Department of Agriculture Circular No. 568. Superintendent of Documents, Washington, D. C. 1940. 10 p. 5 cents.

Nonmetallic Mineral Industries in 1939. U. S. Department of Interior, Bureau of Mines Information Circular 7106. Bureau of Mines, Washington, D. C. 1940. 27 p.

Nutrition of Fur Animals. U. S. Department of Agriculture Yearbook Separate No. 1717. Superintendent of Documents, Washington, D. C. 1940. 22 p.

Protection Against Habit Forming Drugs. U. S. Treasury Department. Superintendent of Documents, Washington, D. C. 1940. 14 p. 5 cents.

Surface Treatment of Steel Prior to Painting. Report BMS 44 on Building Materials and Structures, U. S. Department of Commerce, Bureau of Standards. Superintendent of Documents, Washington, D. C. 1940. 17 p. 10 cents.

The Citrus Industry and Occupations in Florida. By A. R. Mead and others. National Youth Administration for Florida, Tallahassee, Florida. 1940. 182 p. (Mimeographed)

B. Non-Government

Development and Manufacture of Optical Glass in America. By M. H. Eisenhart and E. W. Melson. Bausch and Lomb Optical Company, Rochester, N. Y. 1940. 12 p.

Central Sound Systems for Schools. Committee on Scientific Aids to Learning, 41 East 42nd Street, New York, N. Y. 1940. 69 p. (Free to teachers and administrators)

Minnesota Game and Fish. Minnesota Department of Conservation, State Office Building, St. Paul, Minnesota. (No date.) 32 p.

Courses and Units of Study in Science and Related Fields

A High School Science Program. Curriculum Bulletin No. 7. By Stanley E. Williamson. Curriculum Laboratory, University of Oregon, Eugene, Oregon. 1939. 79 p. 35 cents.

A Research Problem in Chemistry. By Wright E. Owen and others. Los Angeles County Schools Publications. County Superintendent of Schools, 240 South Broadway, Los Angeles, California. 1940. 34 p.

A Wild Life Program for Georgia Farms. State Department of Education, Atlanta, Georgia. 1939. 48 p.

Pets: A First Grade Unit. Curriculum Bulletin No. 9. By Alma Sarpola. Curriculum Laboratory, University of Oregon, Eugene, Ore. 1940. 8 p. 10 cents.

Suggested Course for Teaching of Alcohol, Narcotics and Tobacco. Fresno City School Publications, City Schools, Fresno, California. 1940. 8 p. 10 cents.

Suggestions for Teaching Selected Material from the Field of Genetics. By Anita Laton, Edna W. Bailey and Joseph Schwab. Bureau of Publications, Teachers College, Columbia University, New York, N. Y. 1939. 66 p. 50 cents.

PAMPHLETS FOR THE SCIENCE TEACHER

A. GENERAL EDUCATION

Dramatizations in Safety Education: An Annotated Bibliography. By the Safety Education Projects of the Research Division. National Education Association, 1201 Sixteenth Street, N. W., Washington, D. C. 1940. 55 p. 25 cents.

Guidance Programs for Rural High Schools. U. S. Department of Interior, Federal Security Agency, Office of Education, Vocational Division, Bulletin No. 203. Superintendent of Documents, Washington, D. C. 1940. 10 cents.

How to Make a Community Youth Survey. By M. M. Chambers and Howard M. Bell. The American Youth Commission, American Council on Education, 1939. 45 p. 25 cents.

Teaching Conservation in Elementary Schools. U. S. Office of Education Bulletin, 1938, No. 14. By Effie G. Bathwist. Superintendent of Documents, Washington, D. C. 1940. 125 p. 20 cents.

The Community and Its Young People. By M. M. Chambers. The American Youth Commission, American Council on Education, 1940. 36 p. 15 cents.

Visual Aids Handbook. Curriculum Bulletin No. 40. Cincinnati Public Schools, Cincinnati, Ohio. 1940. 160 p.

B. SCIENCE EDUCATION

Early Embryonic Somatic Movements in Birds and Mammals Other than Man. Monograph V, No. 2. By G. E. Coghill. Society for Research in Child Development, National Research Council, Washington, D. C. 1940. 48 p.

Soil Conservation. By Soil Conservation Service. Superintendent of Documents, Washington, D. C. 1940. 27 p. 10 cents.

The Study of Conservation. By George W. Friedrich. The Department of Conservation and the Department of Education, State of Minnesota, St. Paul, Minnesota. 1940. 56 p.

MISCELLANEOUS SOURCE MATERIALS

By Way of Introduction: A Book List for Young People. By Joint Committee of the American Library Association and the National Education Association. American Library Association, Chicago, Illinois. 1938.

Eighty New Books on Occupations. U. S. Department of the Interior, Federal Security Agency, Office of Education, Miscellaneous Leaflet No. 2395, 1940.

One Dollar or Less. Inexpensive Books for School Libraries. United States Office of Education Pamphlet No. 88. By Edith A. Lothrop, Superintendent of Documents, Washington, D. C. 1940. 16 p. 5 cents.

1000 and One: The Blue Book of Non-Theatrical Films (Sixteenth Annual Edition, 1940–1941). Educational Screen, Inc., 1940. 132 p. 75 cents.

500 Books for Children. U. S. Department of Interior, Office of Education Bulletin (1939) Number 11. By Nora E. Benst. Superintendent of Documents, Washington, D. C. 1940.

Ten Cent Books and Fifteen Cent Books. By Russell L. Reynolds, 536 W. 114 Street, New York, N. Y. 1939. 27 p. 10 cents. (Mimeographed)

Abstracts

GENERAL EDUCATION

SYMPOSIUM. "The University High School Study of Adolescents." *University High School Journal* 18: 1–47; November, 1939.

This is one phase of a report of an investigation sponsored by the General Education Board and directed in the interest of guidance service and curriculum development. This report has to do with the techniques of treating data on characteristics of high school students. —C.M.P.

SYMPOSIUM. "Program of the College of Education." *Educational Research Bulletin* 19: 1–30; January 3, 1940.

This Bulletin describes the evolving program of the College of Education at the Ohio State University, presenting an overview of the study, the characteristics of the audience, and the general assumptions and hypothesis of the program. —C.M.P.

ANDERSON, EARL W. AND RICHEY, ROBERT W. "The Master's Degree for Public School Teachers." *Educational Research Bulletin* 19: 48–52; January 17, 1940.

A Master's degree will soon be required for all secondary teachers. Almost a third of Ohio secondary teachers now hold such a degree. The content of the fifth year of college work should be selected from the academic, cultural and education areas, with more stress upon cultural subjects. Attention should be paid also to the development of the teacher's personality. —C.M.P.

SYMPOSIUM. "City Teachers: Their Preparation, Salaries, and Experience." *National Education Association Research Bulletin* 18: 3–47; January, 1940.

The following aspects are discussed: (1) levels of preparation of teachers in service, (2) years of experience of teachers in service, (3) salaries in relation to preparation and experience, (4) salary schedules in relation to levels of preparation, (5) a look ahead, and (6) studies in teacher education. —C.M.P.

JONES, WILLIAM J. "Some Further Evaluations of a Field Study Experience." *Educational Research Bulletin* 19: 99–104, 116; February 14, 1940.

This is a further report of some of the outcomes which resulted from a ten-day field study which thirteen high-school students of Morgantown, West Virginia, made in New York City in April, 1939. Several students made considerable changes in their social attitudes.

SYMPOSIUM. "Professional Program." *Educational Research Bulletin* 19: 119–147; February 28, 1940.

The orientation program in the Ohio State University College of Education and the evaluation procedures which are based on an intensive program of analysis and evaluation are presented. —C.M.P.

SYMPOSIUM. "Report of the New York Regents' Inquiry and Cooperative Study of Secondary Standards." *Educational Research Bulletin* 19: 149–186; March 13, 1940.

This review includes the following publications: (1) *The Regent's Inquiry*, (2) *High School and Life*, (3) *When Youth Leaves School*, (4) *Education for Citizenship*, (5) *Education for Work*, (6) *The School Health Program*, (7) *Adult Education*, (8) *State Aid and School Costs*, (9) *Preparation of Teachers*, (10) *School and Community*, (11) *Motion Pictures and Radio*, and (12) *The Cooperative Study of Secondary School Standards*. —C.M.P.

ALEXANDER, CARTER. "Teacher Use of Library Materials." *Teachers College Record* 41: 493–505; March, 1940.

This article explains how the teacher may locate and use effectively the library materials relating to teaching and professional growth. —C.M.P.

RUSSELL, WILLIAM F. "A Century of Teacher Education." *Teachers College Record* 41: 481–492; March, 1940.

The author describes the schools and teachers of New York State in the year 1839. —C.M.P.

SYMPOSIUM. "The Laboratory Concept." *Educational Research Bulletin* 19: 187–216; March 27, 1940.

The efforts at the Ohio State University College of Education to develop a laboratory approach to problems of teacher preparation are described. —C.M.P.

SYMPOSIUM. "The Status of the Teaching Profession." *National Education Association Research Bulletin* 18: 51–78; March, 1940.

The following aspects of the teaching profes-

sion are discussed: (1) general composition of the teaching population, (2) educational preparation and certification, (3) professional experience and mobility, (4) salaries and economic conditions, (5) professional load, (6) provisions for tenure, (7) provisions for retirement, (8) professional associations of teachers, (9) mental and physical health, (10) trends affecting the future status of teachers, (11) academic freedom, and (12) sources of information for sections.

—C.M.P.

SYMPOSIUM. "Field Service." *Educational Research Bulletin* 19: 245–274; April 24, 1940.

A description of the field service projects of the Ohio State University College of Education.

—C.M.P.

SYMPOSIUM. "Education and Economic Literacy." *Teachers College Record* 41: 571–668; April, 1940.

This symposium contains the following articles: (1) "Developing Economic Competence Through Public Education," by Erling M. Hunt, (2) "Increasing Knowledge and Rationality About Economics and Business," by E. L. Thorndike, (3) "What Can Be Done Through Education to Eliminate Economic Literacy?" (Digest of Seminars), (4) "How Can Economic Illiteracy Be Reduced? Some Next Steps," by Harold F. Clark, (5) "An Analysis of General Financial Illiteracy from the Standpoint of Business," by Floyd L. Carlisle, (6) "Economic Literacy in Rural America," by Chris L. Christensen, (7) "The Economic Literacy of the Consumer," by Mrs. Randolph M. Binder, (8) "Organized Labor Interprets Economic Illiteracy," by Spencer Miller, Jr., and (9) "The Need for Economic Leadership," by Lamont du Pont.

—C.M.P.

SYMPOSIUM. "Graduate Work." *Educational Research Bulletin* 19: 305–334; May 22, 1940.

The scope, characteristics, and procedures of graduate work in the College of Education at the Ohio State University are stated.

—C.M.P.

SYMPOSIUM. "In Honor of E. L. Thorndike." *Teachers College Record* 41: 695–788; May, 1940.

This issue is devoted wholly to honoring E. L. Thorndike. From 1898 to May 1940, Thorndike has had 441 publications, a record probably unequalled.

—C.M.P.

SYMPOSIUM. "Audio-Visual Aids." *The Phi Delta Kappan* 22: 409–462; May, 1940.

This issue is devoted to audio-visual aids in education. Practice is emphasized and theory is minimized.

—C.M.P.

SCIENCE EDUCATION

PALMER, E. LAWRENCE. "Field Biology in City High Schools." *The Teaching Biologist* 9: 141–144; May, 1940.

The author makes a plea for greater use of the living materials of the environment. Field work should be an integral part of all biology courses —city, small town, or rural high schools. In only this way can biology be made to really function in the lives of boys and girls. There is a wealth of material on every hand.

—C.M.P.

FRANK, J. O. AND DISCHER, C. A. "A Study of Health Materials in High School Chemistry Texts." *Journal of Chemical Education* 17: 236–240; May, 1940.

This investigation involved the analysis of twelve high school texts. Texts published prior to 1936 are in full agreement as to health items, but since that time there is less agreement. In the twelve texts, a total of 2,652 health items were found. The five texts published since August 1936 have 78.6 per cent more health items than the seven texts published prior to that date.

—C.M.P.

SIMMONS, MAITLAND P. "Project—Techniques Relative to Exhibitions." *School Science and Mathematics* 40: 434–438; May, 1940.

The writer presents seven techniques relative to the development of general science exhibits.

—C.M.P.

MANEVAL, ROY V. "The Relative Value of Sound Pictures and Study Sheets in Science Teaching." *The Journal of Experimental Education* 8: 39–43; September, 1939.

This is the report of Field Study No. 2 carried out at the Colorado State College of Education as part of the requirements for the doctor's degree. Field Study No. 1 was reported in the February, 1939, issue of Science Education. The purpose of the study was to determine the value of two methods of direct instruction: (1) by the use of educational sound pictures, and (2) by the use of printed study sheets. The data were collected during the school year 1938–1939 in the Horace Mann and Theodore Roosevelt Junior High Schools of Tulsa, Oklahoma. Eighth-grade pupils were paired according to mental age, science reading ability, and sex. There were 280 pairs remaining at the end of the experiment. Eight sound films on science subjects were used. Results of the experiment, as measured by the instruments used, seem to show that pupils of higher mental ability tend to be taught more effectively by the study sheet method; the average group seems to be taught equally well by either method; and the pupils of lower mental ability tend to be taught more effectively by the sound film method.

—C.M.P.

SYMPOSIUM. "Women Chemists." *Journal of Chemical Education* 16: 574–594; December, 1939.

The following aspects of the status and work of women chemists are discussed: (1) a survey of the training and placement of women chemistry majors in women's and co-educational colleges by Ethel L. French, (2) women chemists in industry by W. S. Landis, (3) training and opportunities for women in chemistry by H. C. Sherman, (4) opportunities for women as research bibliographers by F. W. Adams, (5) opportunities for women chemists in Washington by Ruby K. Worner, (6) experiences in the field of merchandise control by Elizabeth S. Weirick, (7) the woman chemist in the control laboratory by Evelyn Hearsey, (8) writing about chemistry by Cornelia T. Snell, (9) women as patent attorneys, and (10) a backward glance gives a forward look by Mary L. Whitsitt. —C.M.P.

ROSENBAUM, E. J. "Laboratory Work for the Chemistry Part of a General Course in the Physical Sciences." *Journal of Chemical Education* 16: 658–670; December, 1939.

Although the liberal use of demonstration experiments and films effectively supplement the lecture parts of physical science courses, there is still need for laboratory work. This article sets up certain criteria for selecting laboratory experiments and lists several desirable experiments.
—C.M.P.

GLASCOE, P. M. "A High School Course in Chemistry Which Does Not Lead to Repetition in College." *Journal of Chemical Education* 17: 11–15; January, 1940.

Most of the article is given to discussion of criticisms of the present high school chemistry course. Since both secondary chemistry teachers and college teachers agree that the course is far from satisfactory, the author suggests a real revision of the course. The new course would be largely environmental, with much less emphasis on memorization of facts, theories, and laws, and writing and balancing of equations. —C.M.P.

BOWMAN, R. E. "The Chemical Technician." *Journal of Chemical Education* 17: 36–49; January, 1940.

This excellent trade analysis of the chemical technician is divided into two parts: (1) Physical and Mechanical, and (2) Chemical Processes.
—C.M.P.

FRASER, THOMAS P. "Science Survey Courses in Accredited Negro Colleges." *The Journal of Negro Education* 9: 13–21; January, 1940.

Science survey course offerings have had a rapid development in negro colleges. Out of 45 accredited senior colleges, 38 offer science survey courses. One of the seven not offering such courses is a graduate school. —C.M.P.

MARTIN, F. D. "The 1938–1939 College Chemistry Testing Program." *Journal of Chemical Education* 17: 70–76; February, 1940.

A total of 287 colleges participated in the testing program. Results from 10,237 students are included in this report. The wide variability of achievement, both for colleges and individuals, noted in previous reports, is true for the 1939 test.
—C.M.P.

POWERS, SAMUEL RALPH. "The Effects of Instruction in Science on Thought, Feeling, and Action." *Teachers College Record* 41: 405–418; February, 1940.

Too long have scientists assumed an attitude of indifference toward the social consequences of their work. Science teaching so often fails to bring to the pupil a full realization of the significance of science in his daily living. Science teaching can be made to influence desirable thoughts, feelings, and actions. The article cites specific cases in which science has been so taught as to do this. Such studies need to be refined and extended. There is need for better instruments of evaluation of the results of teaching science and for more complete records of their use.
—C.M.P.

HALL, CARROL C. "Concomitant Problems that Arise with the Presentation of the Subject Matter in Secondary Chemistry." *Journal of Chemical Education* 17: 240–249; May, 1940.

This investigation is based primarily on an examination of all issues of the Journal of Chemical Education (first published in 1924) and all issues of School Science and Mathematics published between 1920 and June, 1938. The following problem areas are discussed: (1) proposed bases for course reorganization, (2) the aims and objectives of high school chemistry, (3) the articulation of college and high school chemistry, (4) the selection and choosing of materials of instruction, (5) the determination of course content, (6) the applications of the findings of education and psychology, (7) curriculum problems, and (8) the trends in high school chemistry.
—C.M.P.

EISMAN, LOUIS AND JOSEPH, ALEXANDER. "Demonstrations and Pupil Projects." *The Science Classroom* 19: 4; April, May, June, and July, 1940.

Each issue contains a series of demonstrations and pupil projects. —C.M.P.

ANDERSON, EARL W., EWON, MARY A. AND KELLSTADT, MARIE. "Teaching Opportunities of 1939." *Educational Research Bulletin* 19: 231–234; April 10, 1940.

In 1939 the College of Education of the Ohio State University graduated 522 students prepared to teach, of whom 452 were available for teaching positions. Of these, 73 per cent obtained teaching positions, the same percentage as in 1938.

The better fields were industrial arts, agricultural education, elementary education, home economics, and nursing education. Commercial education and physical education remain good fields. The percent of those obtaining teaching positions in science was: biology 56 per cent, chemistry 71 per cent, and general science 72 per cent. —C.M.P.

SYMPOSIUM. "Consumer Education." *The Teaching Biologist* 9: 81–104; February, 1940.

This issue of The Teaching Biologist contains the following articles: (1) Science and the Consumer, (2) Four Current Concepts of Consumer Education, (3) Business and the Consumer, (4) Consumer Education in the 7th, 8th, and 9th Year Science, (5) A Consumer Education Unit for Use in Biology Courses, (6) Two Lessons, (7) Testing for Outcomes, and (8) Sources of Teaching Materials. —C.M.P.

HALL, CARROL C. "Out of the Hat." *School Activities* 11: 247–248; February, 1940.

Suggestions for a science assembly program are offered. —C.M.P.

DIEHL, IVAN C. "Method of Procedure for an Excursion." *The Journal of Geography* 39: 78–80; February, 1940.

Specific steps in planning for, carrying out, and following-up, an excursion, are given. —C.M.P.

CREWSON, WALTER. "The Local Community as a Resource for Teaching High School Geography." *The Journal of Geography* 39: 105–109; March, 1940.

The author believes that the worst shortcoming of courses in the teaching of geography is the tendency to dwell on the deeply involved theory rather than to get down to cases and teach what to do, and how to do it. Geography teachers need to use the local community much more than they do. Specific examples of how to do this are presented. —C.M.P.

HALL, CARROL C. AND SHARPE, PHILIP B. "A Future—Ama of High School Science." *The Clearing House* 14: 390–392; March, 1940.

The authors state that a physical science survey course will displace the present physics and chemistry courses in the secondary school. Skills, attitudes, and problem-solving will displace the present emphasis on subject-matter. Consumer science seems to offer great possibilities, too. —C.M.P.

MAYROSE, WILLIAM. "A Model of a Modern Sewage Treatment Plant as a Project in High School Chemistry." *Journal of Chemical Education* 17: 167–170; April, 1940.

This article describes a trip to a sewage disposal plant and the follow-up activities. One of the major follow-up activities was the construction of a model of the sewage plant. —C.M.P.

CARTER, HARRIET. "Our National Forests—A Social Problem." *The Journal of Geography* 39: 151–156; April, 1940.

This article includes a study guide for junior- and senior-high schools, basic ideas for the students to understand, suggestions for teachers, and references. —C.M.P.

ASHFORD, THEODORE A. "A Physical Science General Course for Grades 11 and 12." *Journal of Chemical Education* 17: 157–159; April, 1940.

This article presents a description of the physical science program of grades 11 and 12 at the University of Chicago, including objectives, content, methods of instruction, and evaluation of the course. The course consists of four class periods and one double laboratory period per week.

First year units are:

- The Earth, Our Home
- The Ever-changing Face of the Earth
- Motion
- Energy, the Agent of All Change
- The Molecular Nature of Matter
- The Atomic Constitution of Matter
- Electricity at Rest and in Motion
- The Electrical Nature of Matter.

Second year units are:

- The Chemcial Reaction
- Atomic Structure and Chemical Behavior
- Ions and Ionization
- Metals and Non-metals
- Carbon, the Element of Life
- The History of the Earth
- Waves as Carriers of Energy
- Atoms and Stars.

THELEN, H. A. "The Functional Use of Visual-Sensory Aids." *University High School Journal* 18: 125–185; April, 1940.

This article describes effective schemes for utilizing visual-sensory aids. A table (pages 147–185) treats various teaching aids as follows: (1) teaching aid (general category and specific types), (2) function in the unit, (3) example, (4) methods and procedures, and (5) source, preparation. Many science teaching aids appear in this list. —C.M.P.

WAILES, RAYMOND B. "Chemical Stunts with Calcium." *Popular Science Monthly* 136: 192–194, 235; May, 1940.

Descriptions of several interesting experiments with compounds of calcium. —C.M.P.

WALLING, MORTON C. "Bones in Sponges Revealed by Your Microscope." *Popular Science Monthly* 136: 196–197, 238; May, 1940.

Techniques in microscopic examination of sponges are described in this article. —C.M.P.

Book Reviews

Textbooks, Manuals and Tests

Holmes, Harry N. *General Chemistry.* New York: The Macmillan Company, 1939. 700 p. $3.50.

This is a first year college text and wisely, we think, includes considerable descriptive chemistry along with the fundamental principles and modern theories. The book is well illustrated with 200 cuts, chiefly line drawings. There are helpful exercises throughout the text and at the chapter ends. An appendix gives the pH values of hydrogen ion concentrations, various tables and a list of Nobel Prize winners in chemistry since 1900.

—W.G.W.

Hildebrand, Joel H. *Principles of Chemistry.* New York: The Macmillan Company, 1940. 359 p. $2.50.

This book is built upon the unique plan of providing work graded according to the ability of the student. It seems to imply a previous or co-course in general chemistry as this is strictly on principles of chemistry. Material intended for the most capable students is put into fine print as it is considered futile for the average student to master it. It is suggested that the testing also be on a sliding scale—Group 1, easy questions, 50 points. Then follow with increasing difficulty, group 2, 30 points; group 3, 10 points; group 4, 10 points.

The material has been brought thoroughly up-to-date. The chapters are all so good it is difficult to pick out any for special mention. There are tables and a few illustrations. The appendix gives sample examinations.

—W.G.W.

Partington, J. R. *A College Course of Inorganic Chemistry.* New York: The Macmillan Company, 1939. 658 p. $2.50.

Written by a professor in the University of London for college students, this text provides a thorough course in inorganic and physical chemistry. The book is to be commended for its helpful diagrams, numerous equations, historical connections and for its treatment of atomic structure which includes the octet theory. In addition to a strong base of fundamental principles the book is enriched by applications to industrial and everyday uses of chemistry.

—W.G.W.

Harrow, Benjamin. *Textbook of Biochemistry.* Philadelphia: W. B. Saunders Company, 1940. 439 p. $3.75.

Emphasizing the newer conceptions and latest developments in the field of biochemistry, the scope of this volume is such as to serve adequately as a text which meets the requirements for medical, dental, agricultural, home economics and general students. The text is illustrated generously and effectively throughout with graphs, tables, charts and photographs. The chapter on vitamins alone contains at least a dozen photographs, tables of the vitamin units as well as tables of the quantitative value of vitamins in foods and a good discussion of the distribution, function and assay of the vitamins. A list of selected readings is to be found at the end of each chapter. In addition to meeting the requirements as a text for the college student, it might well serve as a desirable reference book for the teacher of biology and science in the secondary schools.

—Ruth Gerber.

Frobisher, Martin, Jr. *Fundamentals of Bacteriology.* Philadelphia: W. B. Saunders Company, 1940. 653 p. $4.00.

The importance of bacteriology in a well-rounded education is recognized today as never before. This book offers a broad and unspecialized treatment which furnishes a basis for general education or for future study of those who wish to continue in special fields. It gives an introduction to the activities of bacteria and their importance to those interested in medicine, industry, agriculture and chemistry as well as from just a cultural standpoint of the general student. The book is divided into three sections: (1) Fundamental Principles; (2) Class Schizomycetes; and (3) Industrial and Medical Aspects of Bacteriology. There are 326 excellent illustrations.

—W.G.W.

Greaves, Joseph E. and Greaves, Ethelyn O. *Elementary Bacteriology.* Philadelphia: W. B. Saunders Company, 1940. 587 p. $3.50.

This is an absorbing story of those smallest living things that "are man's most useful servants and his most destructive master." Bacteria have conquered nations ignorant of their presence or power. But today science shows the way to control them. This book gives a classification of microorganisms and presents interesting facts about both the injurious and the helpful microbes. Applications in the arts, industries and medicine are discussed at length. The new science dealing with viruses and bacteriophage brings the subject right up to the present state of research. The book will find a useful place as a text in elementary bacteriology for nurses, medicine students, home economic workers and others who are interested in the invisible world of living things about us. There are 164 illustrations.

—W.G.W

NEWMAN, H. H. *The Phylum Chordata.* New York: The Macmillan Company, 1939. 477 p. $3.60.

This text is excellent in presentation of the chordate animals and will no doubt find use for courses in vertebrate zoology and comparative anatomy. All the larger branches of the chordates are well represented and the anatomical comparisons are easily made.

Professor Newman is to be complimented on the preparation of a book of this type which will supply a great need in the field.

—E. C. Harrah.

WALTER, HERBERT EUGENE. *Biology of the Vertebrates.* New York: The Macmillan Company, 1939. 882 p. $4.00.

This revised edition is greatly improved and very much reorganized with the addition of nearly 100 pages of material and more than 80 new illustrations. It is much improved over the first edition, is much more easily read, and the illustrations in general are greatly improved.

This book no doubt will find a much wider use in its revised form than the original edition. The organization is still on the basis of systems of organs which gives a comparative point of view and to the writer is the point of view that vertebrate zoology ought to take.

The author and the publisher are to be commended for the improvement that has been made in this text.

—E. C. Harrah.

PEARL, RAYMOND. *Introduction to Medical Biometry and Statistics.* Philadelphia. W. B. Saunders Company, 1940. 537 p. $7.00.

This is the third edition, revised and enlarged, of an excellent textbook first published in 1923. Some materials have been omitted that are now readily available in government publications, many pages have been rewritten, much new material has been added. Generations of students have proved it to be a very teachable book. It will continue to even better serve many others in its revised form. Statisticians of health departments, city, state, and national, of insurance companies and the medical fraternity will use it most. Even the laymen will appreciate such chapters as Graphic Representation of Statistical Data and Life Tables—how such are constructed. It is a fine piece of work.

—E.R.D.

SEMAT, HENRY. *Introduction to Atomic Physics.* New York: Farrar and Rinehart, Inc., 1939. 360 p. $3.50.

Introduction to Atomic Physics would seem to be an excellent textbook for a course in atomic physics either in the physics or chemistry department. It presupposes one year of college physics and a course in calculus. Students and teachers reading this treatise will have excellent information regarding present ideas concerning the structure of the atom and the nature of its constituent particles.

—C.M.P.

KRUEGER, WALTER W. *The Fundamentals of Personal Hygiene.* Philadelphia: W. B. Saunders Company, 1940. 304 p. $1.75.

In this completely up-to-date third edition, Krueger simplifies the health problem of modern life and the every-day problem of teaching healthful living. The author, who is a teacher, strives to present the important principles and fundamentals of personal hygiene so that each recommendation may become an active, functioning part in the student's daily health program. Since the facts of hygiene have value only to the extent to which they are applied, an effort has been made to improve the student's judgment and health information which he receives by giving careful attention to mental health to show that correct ideals, desires, and attitudes are important. The questions for class discussions and the selected bibliographies at the end of each chapter will be stimulating to those who teach personal hygiene as well as to any lay reader or teacher of biology, for health maintenance is a matter of personal responsibility.

The book is illustrated and desirable types of exercises are included.

—Greta Oppe.

SMILEY, DEAN, AND GOULD, ADRIAN GORDON. *A College Textbook of Hygiene.* New York: The Macmillan Company, 1940. 539 p. $2.50.

This is the third edition of one of the finest textbooks on hygiene that the reviewer has happened across. Much new material has been added to this comprehensive treatise. The material is presented in such an unusually interesting and attractive style that it can be read with the enjoyment of a popular book. It is an excellent reference book for high-school biology and college-biology survey courses.

—C.M.P.

WILLIAMS, SIDNEY J. AND CHARTERS, W. W. *Safety.* New York: The Macmillan Company, 1940. 451 p. $1.60.

Schools are introducing organized courses in safety with increasing frequency. Here is a textbook to meet the demand created by such courses. The text is intended for pupils at the high school level. It is simple enough, however, for pupils in junior high school or the upper grades.

The organization of material begins with the prevention of common school accidents and proceeds through the home accidents, walking, automobile driving and travel, to the problem of cooperation in accident prevention. The treatment is positive, telling what to do to avoid accidents rather than just detailing the common causes of such accidents. Graphic illustrations serve to point these positive directions.

The book is recommended to teachers looking for a textbook in safety or to teachers looking for supplementary reference material for science courses.

—R.K.W.

FRANCIS, CHARLOTTE A. AND MORSE, EDNA C. *Laboratory Manual* to accompany *Fundamentals of Chemistry and Applications.* New York: The Macmillan Company, 1940. 152 p. $1.00.

This manual has been written to accompany *Fundamentals of Chemistry and Applications.* The manual is planned for use in chemistry courses of from forty-five to one hundred and twenty hours.

The plan as outlined is that which the authors themselves are using in a forty-five hour course in chemistry that is intended primarily for nurses. Chemistry manuals as they are written today rarely ever reflect the personality of the authors and their successful teaching. However, the reviewer, herself a teacher of chemistry to nurses for five years, wonders if the manual would not have an added significance if the function of chemistry in the life of a nurse were more definitely and clearly shown.

Accompanying the manual is *A Teacher's Guide* offering suggestions to the "busy or inexperienced teacher of chemistry." This is distributed free.

—Greta Oppe.

CURTMAN, LOUIS J. AND EDMONDS, SYLVAN M. *Calculations of Qualitative Analysis.* New York: The Macmillan Company, 1940. 156 p. $2.00.

If you are looking for a thoroughly modern treatment of the calculations which arise in the theory and practice of qualitative analysis your quest may well be ended. For that is just what you will find in this book. The problems found here will offer ample testing of the student's mastery of theory. The ten chapters cover: properties of strong and weak electrolytes; chemical equations; calculations based upon chemical formulas and equations; solutions; calculations involved in non-redox and redex reactions; chemical equilibrium and ionization; solubility products; ionization of water-oxonium concentrations; complex ions; theory of redox reactions. There is a useful appendix of significant figures, exponents, logs and log tables.

—W.G.W.

KELSEY, ERWIN B. AND DIETRICH, HAROLD G. *Fundamentals of Semimicro Qualitative Analysis.* New York: The Macmillan Company, 1940. 350 p. $2.75.

This book has two divisions: (I) Fundamental Theory (188 p.) and (II) Analytical Procedure (146 p.). The principles involved relating to solution equilibria, properties of ions, and analytical procedure are about the same as for macro analysis. In semimicro analysis reduced-size apparatus, smaller amounts of solution are used and the centrifuge replaces filtration. The discussion of principles is thorough, the equations are adequate and the questions and exercises for review are ample. The special equipment required is described and complete equipment and solutions are recommended for each student's desk. There is a valuable appendix containing logs, apparatus list, composition of practice solutions and table of solubility products. —W.G.W.

DAVIS, R. E., SMITH, H. R., MCGILL, MARTIN V., BRADBURY, G. M., AND HOPKINS, B. S. *Chemistry and You in the Laboratory.* Chicago: Lyons and Carnahan, 1939. 318 p.

This laboratory manual presents a series of experiments to accompany the text, *Chemistry and You.* The nature of these units, sixteen in number, would permit its use, however, with any text. Each of the units is composed of the following sections: Object, Leading into the Experiment, Material needed, What to do, and Conclusion. There are seventy-eight experiments. Many of the experiments also include suggestions for advanced work thus affording abundance of material to meet the needs of a high school course. There are suggestions to integrate the work with other subjects, such as physics, the machine shop, and so forth. The nature of the manual may be briefly summed up in the words of the authors: "Each experiment is presented to teach some fact or principle." The reviewer misses in the manual the stimulating effect produced by the text.

The manual may be obtained either in the bound or loose-leaf edition.

—Greta Oppe.

MATHESON, ROBERT. *A Laboratory Guide in Entomology for Introductory Courses.* Ithaca, N. Y.: Comstock Publishing Company, 1939. 135 p. $2.00.

This laboratory guide is well prepared and covers quite fully the field of entomology. It provides for the student the things that are not usually well illustrated or explained in the textbooks, and the diagrams that are given would be a tremendous aid to the student in identifying many of the species of insects. It has, of course, the same difficulty that most of the recent manuals have in that it leaves little for the student to do in the laboratory. The keys that are furnished and especially the diagrams of wing venation would no doubt be a tremendous aid in elementary courses in entomology.

A glossary of technical terms is supplied for the benefit of the student. This laboratory guide will fill a place in many courses in entomology.

—E. C. Harrah

BUSH, GEORGE L., DICKIE, ALLAN, AND RUNKLE, RONALD C. *Activities to Accompany a Biology of Familiar Things.* New York: American Book Company, 1939. 252 p.

This is a student's workbook to accompany the author's *A Biology of Familiar Things* previously

reviewed in *Science Education*. The workbook furnishes useful aids and additions to the study of biology. There are study exercises, experimental investigations and related activities, and self-testing exercises.

—C.M.P.

ADAMS, ROGER AND JOHNSON, JOHN R. *Elementary Laboratory Experiments in Organic Chemistry.* New York: The Macmillan Company, 1940. 420 p. $2.00.

This is a bound cloth-covered book, but with perforated pages with alternate pages blank for laboratory notes. In this third edition additions have been made to keep step with the progress in synthetic organic chemistry. The first section covering 94 pages is devoted to experiments on *laboratory operations:* melting points, crystallization, distillation, boiling points, solvents, and salting out. The remainder of the book takes up the *preparation and reactions of typical organic compounds.* An appendix includes tables, outlines, materials and treatment for burns and accidents.

—W.G.W.

MARSLAND, DOUGLAS AND BRANDWEIN, PAUL F. *Manual of Biology:* Part I, *The Protozoa and the Plant;* Part II, *The Metazoan Animals.* New York: Henry Holt and Company, 1939. 176 p.; 211 p. $1.25, each.

This laboratory manual is well gotten up and covers the field admirably, but it has the difficulty of many of the recent manuals. It leaves little for the student to do individually in the laboratory. Unless there is to be no laboratory work for the course, it appears that it would be better than reproduce, of his own volition, what he has then reproduce, of his own volition, what he has seen. Of course, a manual of this type saves a great deal of time for the student and that is an important factor.

It seems that this manual is as good as any. Part I covers the single-celled animals and plants and the algae, liverworts and mosses, the germs and the seed-bearing plants.

Part II deals exclusively with the metazoan animals covering quite well the frog, the earthworm, and the rat. The Coelenterata, flatworm, earthworms, the clam, the starfish, the lobster, and the grasshopper are covered less fully.

In this part the author deals with the material in quite scientific style and it would necessitate that the vocabulary of the student would have to be quite large in order to make the interpretations.

—E. C. Harrah.

AVERY, MADALYN. *Household Physics. Laboratory Manual.* New York: The Macmillan Company, 1940. 92 p. $1.50.

This manual describes twenty-five experiments and includes space for student records. The experiments are of the quantitative type and have been planned for a 3-hour period. Diagrams are helpful. Many sets of questions focus the attention upon important facts. They also serve as review questions. Many of these questions help to show the relation between science of the laboratory and science of daily living. The use of this manual and experience gained from the laboratory will greatly add to the value of any course in household physics.

—W.G.W.

JONES, SAMUEL I. *Mathematical Clubs and Recreations.* Nashville, Tenn. (1122 Belvidere Drive): S. I. Jones Company, 1940. 236 p. $2.75.

Mathematics, science teachers, and laymen interested in "brain teasers," solving mathematical puzzles, and so on will find this a most fascinating work. Part I discusses mathematical clubs and will be found most useful and practical for many classroom mathematics teachers. Part II includes many mathematical recreations (amusements, brain teasers, brain nuts, curious tables, multiplication oddities, number rhymes, games, puzzles, and riddles, fallacies, calendar magic, and bible tests) which science teachers and laymen will find interesting and enjoyable. And by the way, for those who cannot quite make the brain teasers "come out right" Part III lists solutions for the problems of Part II.

—C.M.P.

FOWLER, GEORGE WINEGAR. *Achievement Tests in Chemistry.* Boston: Ginn and Company, 1939.

"Good tests are teaching tests," the author writes in his foreword. "Satisfaction will come to the pupil because he will know not only wherein he has succeeded but also wherein he has failed." I would add, as a teacher, that good tests are teaching tests because they also show wherein the teacher has succeeded and wherein he has failed to help the pupil master the facts and their principles and applications. We need more achievement tests embracing a wise choice of questions that actually measure teaching and pupil growth. This group includes 14 tests embracing principally fours types of materials: Type I. Statements that are either correct or incorrect; but instead of being just true-false questions, the test requires the false statement to be corrected by the proper insertion of a word or words thus enhancing the value of the test by leaving with the pupil the verity and not the falsity of the statement; Type II. Statements that may be completed by choosing the best answer; Type III. Statements that may be completed by supplying the correct word or words, and Type IV. Questions or statements that may be identified by such words as name, state, write, or give. The chemical facts, principles, and applications are tested so well in this group of tests that I feel the urge to express the wish that the author would include just one more type of questions to "quiz" the present attitudes of students

to the end that our teaching may give them greater understanding for lasting appreciations. —Greta Oppe.

MCGILL, MARTIN V. AND BRADBURY, G. M. *New Chemistry Unit and Review Tests.* Chicago: Lyons and Carnahan, 1939. 47 p.

Chemistry Unit and Review Tests are designed to accompany the 1939 edition of *Chemistry Guide and Laboratory Exercises.* There are fourteen of these tests and a final review test for each semester. Each test is made up of forty questions, briefly and simply stated, to be answered mostly by filling in blanks. A number of drawings are interspersed throughout the tests requiring the student to summarize the high points of his experience while using a particular piece of apparatus. In formulating test questions for beginners in chemistry, it seems so much wiser to focus attention upon possible errors; for example: Metallic oxide plus water yields (a) acid, (b) base, (c) salt; therefore, why tack on (d) decomposition, (e) no action? Fortunately, there are not many of this type included in the review tests. —Greta Oppe.

SCIENCE REFERENCE BOOKS

GOLDSCHMIDT, RICHARD. *The Material Basis of Evolution.* New Haven: Yale University Press, 1940. 436 p. $5.00.

The author believes that evolution by the accumulation of small variations leads to diversification within the species (subspecies, polymorphism) but never to the decisive step from one species to another. And yet he devotes 183 pages to such microevolution, as he calls it, which he does not regard as the material basis of evolution.

What he does believe is "that the large departures produced in a single step by what we call systemic motation offers the feasible method of macroevolution on and above the specific level" (p. 309).

"According to the theory of the gene each individual gene exercises a definite influence upon the development of morphological and physiological characters" (p. 218). "The classical theory of the gene as an actually existing unit, lying in the chromosome like a bead in a chain, is no longer tenable" (p. 247). But "the germ plasm as a mole controls the general features of development which lead to a definite type, the species in question" (p. 218). A change in the chemical pattern of the germ plasm produces a systemic mutation "Let us compare the chromosome a very long chain molecule of a protein" (p. 248) "the mechanics of the possible changes from one type of protein to another . . . may be described in terms equivalent to the words breakage, inversion, translocation, deletion, rearrangement" (p. 249).

There is presented a wealth of factual material from his own studies and the many investigations cited in the bibliography of 22 pages. But it is poorly organized. It would enhance the value of the book if the author would state his theses seriatim, then give the facts to prove them. As it is you wade through page after page of evidence without knowing what it is all about. It is to be highly commended for its summaries of facts and its critical discussions. It requires study not merely reading. —E.R.D.

YATES, RAYMOND F. *Machines Over Men.* New York: Frederick A. Stokes Company, 1939. 249 p. $2.50.

Regarding robots, the author says: "We damn them, praise them, fear them or justify them, depending upon our outlook, our profession, or business." The author in this treatise is concerned with the robot as a robot, rather than with the social consequences of its ever-increasing, ever-more-efficient presence. And Homo mechanicus electricus is only in its infancy, or at least no farther along than the kindergarten!

The author describes many of these labor saving devices: A simultaneous calculator that solves simultaneous algebraic equations to nine or more unknowns in one operation which might require days by ordinary operations; a bottle blowing machine that molds 3,600 bottles an hour compared to the few hundreds of a whole day's work a few years ago; incandescent lamp machines turning out 9,000 times as many per man-hour; and so on.

Most of these robot machine operations are performed either by the photo-cell, vacuum tube amplifiers, oscillating vacuum tubes, or by electronic rectifying tubes. Claiming his list is only partially complete, the author lists 29 types of counting and measuring robots, 61 industrial, 29 traffic, 14 grading, 51 scientific, 10 medical applications, 16 light measurement, 10 sound control, 7 visual reproduction, 17 electric power systems, 24 printing and publishing, 21 safety devices, 12 home possibilities, 11 communication, 4 sports, and 22 food and chemical processes robots.

Yes, the robot has come to stay, bringing with it one of the most difficult problems modern man faces. The author believes that in order to cope with the robot it is imperative that it be understood how it acts, sees, hears, smells, thinks, reproduces its kind, and how it is adding to its almost unlimited strength and even more incredible intelligence.

Machines Over Men is a fascinating book to read even for the laymen, but more especially for the science teacher and student. High school students will find no difficulty in reading the book. Most of those having scientific interests will thoroughly enjoy it. —C.M.P.

WELLS, H. G. *The Fate of Man.* New York: Alliance Book Corporation, 1939. 263 p. $2.50.

According to the blurb "This is probably the most closely reasoned and the most comprehensive book that even H. G. Wells has ever pro-

duced. Tautly written, passionately conceived under the stimulus of present day realities, it sums up the world situation and sets out in full the social, political, and scientific implications of the Wellsian philosophy, interspersed with brilliant portraits of world personalities—Roosevelt, Stalin, Chang Kai Shek, Hitler, Chamberlain, etc."

In the second half of the book the author analyzes the world movements of today—Christianity, British Imperialism, Naziism, Communism, Japanese Shintoism, Jewish Zionism and Amercian New Deal-ism. Wells estimates their possibilities for good and ill.

The keynote of the book is extreme pessimism for the probable fate of mankind—an outlook shared by other noted men such as Hooton (The Twilight of Man) Dean Russell of Teachers College (Teachers College Record, December 1939, p. 194 and following), Joseph Kennedy, Ambassador to Great Britain, and numerous others. In this book Wells says "Adapt or perish." And he further states that we must adapt now and here—radically, unequivocally. He outlines the essentials of the necessary changes for the new democratic life—the rule of law equalitarianism and cosmopolitan outlook, collective economy or socialism, and universal education.

In his last chapter on Decadent World Wells says, "The human process will go back, it may be fancied, to a mechanically feeble barbarism—It will be the Dark Ages over again, a planetary instead of a merely European Dark Ages—There will be a return to primitive home-made weapons, non-mechanical transport, a new age if not of innocence, yet of illiteracy, and slow, feeble and less lethal mischiefs will return to the world—The coming barbarism will differ from the former barbarism by its greater powers of terror, urgency and destruction, and by its greater rapidity of wastage—(the only alternative is)—adapt or perish."

If the fate of man is as gloomy as portrayed and the only alternative the rapid adaptation urged by Wells, then the fate of man is indeed hopeless. With these pessimistic forebodings, the reviewer takes issue. But of what weight is our humble opinion compared to those of Wells, Hooton, Russell, Kennedy, and others? Yet the reviewer is more in agreement with the opinion expressed at the Columbus meeting of the American Association for the Advancement of Science by Dr. Kirtley F. Mather, famed Harvard geologist—"Don't despair, little man, you're only a child, and doing fine." There is a golden age of civilization ahead for Homo Sapiens and present disturbances are only the reverberating echoes of man's recent barbaric state. Man is only in the infancy stage of his domination of the earth.

You will want to read *The Fate of Man*, if for no other reason than to affirm or dissent from the opinion of Wells, Knight of Pessimism.

—C.M.P.

HALDANE, J. B. S. *Science and Everyday Life.* New York: The Macmillan Company, 1940. 284 p. $2.00.

Professor Haldane has been since 1937 professor of biometry in the University of London. His numerous scientific papers and his popular books have a wide following on both sides of the Atlantic. His simple style and entertaining and original point of view make this collection of essays equally as valuable to the student of science as well as to the ordinary reader. To the teacher of science attempting to show that science does affect everyday living "Science and Everyday Life" offers some seventy articles dealing with various aspects of science. It is a distinct contribution to this distinctive need.

Here is a tremendous amount of information that the average man wants to know about: meals, weather, stars, the earth, mathematics and physics, evolution, medicine and society, drugs, heredity, and science and society. How pleasantly such information is conveyed is shown by scanning through the essays and reading their titles: "Bread and Ham," "Weather and History," "Some Mathematical Conundrums," "Atom Smashing," "Bad Air," "Industrial Diseases," "Fuel Values," "Germ-killers," "Pain-killers," "My Job," "Some Great Scientists Today."

—Greta Oppe.

HARTMAN, GERTRUDE. *Machines and the Men Who Made the World of Industry.* New York: The Macmillan Company, 1939. 278 p. $2.50.

Machines have affected our environment in a great many ways. In this book the author tells interesting stories about old and new machines and the inventors whose research and whose convictions are responsible for the astonishing progress of the modern world.

Some of the chapter titles are: Spinning Jennies and Weaving Johnnies; Eli Whitney Invents the Cotton Gin; The Quest for Power; Fulton's Folly; Traveling Engines; Striking Oil; Kelly's Kettles; Making Rubber Useful. Stitch! Stitch! Stitch!; Dots and Dashes; Telegraphing under the Sea; When Wires First Talked; A New Light for the World; Machinery Comes to the Farm; The Horseless Carriage; Sending Messages without Wires; and Man Learns to Fly.

This book is illustrated with a large collection of old prints, photographs, and charts. It would serve as an excellent reference book for boys and girls of the upper elementary grades or the junior high school.

—Roy V. Maneval.

GRAHAM, HARVEY. *The Story of Surgery.* New York: Doubleday, Doran and Company, Inc., 1939. 425 p. $3.75.

"Surgery," Harvey Graham writes, "was born of a queer muddle of demonology, tribal ritual and social necessity, but in the earliest civilizations it developed rapidly into a lusty infant art." This development the author traces in *The Story*

of Surgery from the earliest operation known to man—performed by a Neolithic surgeon, wielding a razor sharp flint—to the white-clad surgeon in the scientific operating room of today. It is the story of the growth of the science that deals with the failures of preventive medicine, the story of the development of an art which had to grope its way through the darkness of ignorance, superstition, and false theory.

Woven around the life stories of the men who have made modern surgery possible, is intermingled the accounts of old superstitions, beliefs and curiosities of medicine, of the strange practices of charlatans and quacks, and of the curious prejudices which have hampered the surgeon's work.

Altogether this is the finest, most absorbing account of surgery and medicine that the reviewer has ever read. It seems rather strange that the author, said to be a prominent British physician, should desire or feel the need to hide behind the pseudonym Harvey Graham. Rather it would seem to be a great honor to be the author of such an outstanding book. All parts of the treatise are interesting, absorbing reading. However the reviewer found the reported activities of the English grave robbers of a century ago a most strange narrative—and occupation. The demand for bodies to be used for purposes of dissection, resulted in high profits for small outlay. Practices and methods used by modern American racketeers never approached in violence and gruesomeness the activities of rival resurrection kings of the latter part of the eighteenth and the first third of the nineteenth century. However most of the book is more pleasant, if less enlightening. General readers, science teachers, and students with probable vocational interests in medicine will thoroughly enjoy this excellent narrative.

—C.M.P.

HAMILTON, W. J., JR. *American Mammals.* New York: McGraw-Hill Book Company, Inc., 1939. 434 p. $3.75.

American Mammals as a reference text will be of more than passing interest to the layman, teacher, and even professional zoologist. This new book on the subject of mammals is distinctively new in that, unlike other books on this subject, it approaches mammals from an ecological standpoint illustrating how mammals are adapted to their environment, why they have certain habits, and what their economic relations are. Here one may find all the recent advances in control together with a full discussion of the esthetic as well as the economic value of North American mammals. Perhaps the nearest approach to a work of this sort is Cabrera's *Manual de Mastozoologia* or Weber's *Die Saugetiere*, but in both of these volumes the emphasis on structure and habits is obviously not on North American forms. This volume includes all the mammal families of North America from Panama to the Arctic Barrens. The drawings, many of them, have been made from live specimens at the New York Zoological Park or elsewhere or from the Cornell University Museum. Among the topics discussed by the author in regard to the mammalian population of North America are: ancestry of mammals, classification, adaptations, food and food storage, reproduction, homes of mammals, hibernation, migration behavior, distribution, useful and harmful mammals, game mammals, fur-bearing mammals, predatory mammals. The author has given a general view of a vast and fascinating animal group hoping that the "inquisitive" reader may find without long search the salient habits of this group of the animal kingdom. Excellent bibliographies at the close of each chapter encourage the reader to read further on any particular order, family or genus. "Predatory Mammals" is an illuminating chapter on the complexity of predation and its relation to wild life control. Until predator-prey relationships are better understood, many of our most desirable mammals will continue to be persecuted.

—Greta Oppe.

KLINEFELTER, LEE M. *Medical Occupations for Girls.* New York: E. P. Dutton and Company, Inc., 1939. 320 p. $2.00.

Many high school girls wish information about medical occupations open to them. This book gives data concerning such vocations, including qualifications necessary, opportunities available, and the advantages and disadvantages of women in each field. This is a story of a First Aid class of high school girls, who study medical occupations under their teacher, a woman physician. They study about the physician, medical specialists, the dentist, chiropodist, dental hygienist, dietitian, medical technologist, nurse, occupational therapy technician, optometrist, pharmacist, physical therapy technician, and the x-ray technician.

At the end of each chapter is given a bibliography and a list of approved schools for the vocation discussed. Photographs are used to illustrate the different medical professions. This unique book would be of interest to high school girls who are not decided as to their life work.

—Roy V. Maneval.

KLINEFELTER, LEE M. *Medical Occupations for Boys.* New York: E. P. Dutton and Company, Inc., 1938. 287 p. $2.00.

Often teachers are called upon to give vocational guidance to students. This book should be available for the teacher to give to those boys who are interested in medical occupations. Through his "average" boy, Joe Wright, the author interviews physicians, specialists, medical technologists, physical therapy technicians and occupational therapists, x-ray technicians, chiropodists, dentists, dental technicians, the Government Medical Service, male nurses, optometrists, pharmacists, and veterinarians.

With Joe, the reader learns the qualifications

necessary for each occupation, as well as the opportunities in each field. At the end of each chapter is a list of books for suggested reading. Accredited schools for the various vocations are given throughout the book.

Because of its interesting narrative form as well as its store of information, this book should be of interest to many high school boys.

—Roy V. Maneval.

REPORT OF THE SUBCOMMITTEE ON TECHNOLOGY TO THE NATIONAL RESOURCES COMMITTEE. *Technological Trends and National Policy Including the Social Implications of New Inventions.* Washington, D. C.: Superintendent of Documents, 1937. 388 p. $1.00.

This report on technological trends and their social implications may be read with profit by all laymen, but is of greatest significance for teachers of science in colleges and in secondary schools. Teachers of science survey courses and those in charge of the training of science teachers will especially find this report timely and interesting.

Part one discusses the social aspects of technology as follows: (1) National policy and technology, (2) The prediction of inventions, (3) Social effects of inventions, (4) Resistance to the adoption of technological innovations; and (5) Unemployment and increasing productivity.

Part two on science and technology discusses: (1) The relation of science to technological trends and (2) The inter-dependence of science and technology.

Part three on technology in various fields discusses (1) Agriculture, (2) The mineral industries, (3) Transportation, (4) Communication, (5) Power, (6) The chemical industries, (7) The electrical goods industries, (8) Metallurgy, and (9) The construction industries.

—C.M.P.

MAJER, FREDERIC. *Our Country's Money.* New York: Thomas Y. Crowell Company, 1939. 121 p. $2.00.

This is a story of our great currency system. The first part of the book is given over to the history of money—how people first used almost anything for money—tiger claws, fish, fur, large stones, beads, shells, spices, salt, animals, boars' tusks, and so on. In Sweden two hundred and fifty years ago coins weighed 31 pounds apiece. Credit for the invention of coinage is credited to merchants of the Kingdom of Lydia. But money-making did not remain long in the hands of private merchants. Rulers took over control of coinage, declaring it to be the right of government.

Paper or leather money was used in Babylon some 3,000 years ago, and in China before 140 B.C. The oldest specimen of actual paper money is a Chinese note dating back to 1368 A.D.

Money serves four main purposes: A medium of exchange, a measure of value, a storehouse of value, and a standard for future payments.

The history of our metal and paper currency system is traced. Many coins formerly used are no longer coined. We have about seven billion dollars in circulation, about one billion of which is in metal. The United States has more than 17,000 tons of gold stored away, over half of that of the entire world. It is worth roughly about 17 billion dollars. The gold is in the form of bricks, each worth about $14,000. In the storehouse at Fort Knox there are stored about five and half billion dollars of gold.

The author describes our minting system and the process of turning out paper currency. The treatise, documented with numerous photographs, affords interesting reading for all boys and girls, as well as adults.

—C.M.P.

NEILL, HUMPHREY B. *48 Million Horses.* Philadelphia: J. B. Lippincott Company, 1940. 241 p. $2.50.

This is the story of the rapid progress in the development of electricity since Thomas Edison in 1882 opened the first Central station, The Pearl Street Station in New York. Now we are using nearly 50 million horse power of electrical energy. In this book the author portrays in human terms what the work of electricity means in industry, in the home, and in entertainment.

The author traveled over 5,000 miles to collect the data for this story of modern power. Much of the material and many of the photographs and illustrations relate to the General Electric Company. The story is vividly told in non-technical language. There are six units as follows: Energy, Light, Comfort, Tele-magic, Transportation, and Industry.

Throughout the social implications of this phase of science are either directly stated or implied. It is an excellent book for the junior and senior high school science book shelf, for students in college science survey courses, for teachers in elementary science, junior high school science, secondary school science, and college science survey courses, and for all laymen who would like to read a real success story in one field of applied science.

—C.M.P.

PILGRIM, MARIETTE SHAW. Alaska. Caldwell, Idaho: The Caxton Printers, Ltd., 1939. 296 p. $3.00.

This book on Alaska, replete with many photographs, discusses the history, natural resources, geography and government. In so far as possible, all facts have been verified. The author is a former elementary teacher in the Alaskan schools.

Written in straightforward, simple manner, the book may be easily read by pupils in the upper elementary grades. *Alaska* is an excellent supplementary book for geography classes. Grown-ups, too, will find much valuable information about our relative of the far North.

—C.M.P.

WOODBURY, DAVID O. *The Glass Giant of Palomar.* New York: Dodd, Mead and Company, 1939. 368 p. $3.00.

The human story behind American astronomy, culminating in the world's largest telescope, is given in this volume. Nearly everyone has followed the press and radio reports of the making of the 200-inch telescope which will be located on Palomar Mountain in California. The complete story of the successes and failures in making the telescope is given in this book, which has been so suitably named.

The book is divided into four parts. The first part, *Ancestry,* gives brief descriptions of the world's outstanding astronomers, and the building of some of the larger telescopes. *The Giant Is Born* tells of the difficulties which were overcome in the moulding of the lens. *The Giant Is Reared* tells of the trip westward and the grinding of the lens. The last part, *The Voyage Begins,* tells what may be expected from the telescope when it is completed.

The author emphasizes the way men have devoted their lives to astronomy. He gives a special tribute to the late Dr. George Ellery Hale. The author, an engineer, is well qualified to write the story of this million pounds of glass and steel. The book is illustrated with sixteen pages of photographs, and with many sketches drawn by the author. This fascinating story should find a place in schools and public libraries.

—Roy V. Maneval.

HOLT, ALFRED H. *American Place Names.* New York: Thomas Y. Crowell Company, 1938. 222 p. $1.75.

As one travels about the United States, listens in on the radio, or reads the newspaper, one often thinks how queer or how quaint certain place-names are and how differently pronounced. The reviewer is reminded of his own experience with the name *Lafayette*—pronounced three different ways in three different states.

The author lists the name alphabetically, gives the pronounciation of the name both by markings and by rhymes. Many of the latter are exceedingly amusing, making the book far from dry-as-dust. One wonders how so many strange names and stranger spellings, ever came into existence. This is an informative book, excellent for the geography teacher, the tourist, and others interested in "how is that name spelled or pronounced."

—C.M.P.

HERTZ, EMANUEL. *The Hidden Lincoln.* New York: The Viking Press, 1938. 461 p. $5.00.

While not a science book, all Americans will find in *The Hidden Lincoln* one of the most absorbing biographies ever written—one of the most important of all of the thousands of books that have been written about Lincoln.

This book is based primarily on the letters and papers of Lincoln's law partner, William H. Herndon. Herndon laboriously collected much information from all Lincoln's early acquaintances. These letters and papers are included in this work. Not so far removed from this generation, much of myth has grown up about Lincoln. In 500 or a 1000 years he will probably seem a mythical character. If you enjoy biography, or are an admirer of one of the greatest of Americans you will surely appreciate this book.

—C.M.P.

VAN METRE, T. W. *Trains, Tracks, and Travel.* New York: Simmons-Boardman Publishing Corporation, 1939. 341 p. $3.50.

This is the fifth edition of a book first published in 1926. Since that date it has been recognized as the finest book on trains that has been published. Many changes have been made in this new edition. The rapid growth in the use of Diesel engines and toward streamliners are emphasized by the increase in size of the book.

The author is Professor of Transportation at Columbia University. Writing with directness, simplicity, and vividness, he unfolds the epic romantic story of American railroads. The book constitutes a real compendium of information about trains and railroading. Probably in no other source can so much accurate, readable information be obtained. There are over 300 photographs to enhance the value of the book.

The book will appeal alike to men and boys, and many women and girls as well. It is a fine supplementary book for a unit on transportation, for classes in general science, physics and physical science courses. No finer book on transportation could be added to the high school library book shelf.

—C.M.P.

MORGAN, ALFRED P. *The Pageant of Electricity.* New York: D. Appleton Century Company, 1939. 363 p. $3.50.

This is an absorbing narrative woven around the lives and achievements of the men whose curiosity, imagination, and patience unlocked the secrets of electricity. No attempt has been made to go deeply into the intricacies of electrical phenomena yet the pageant of electricity is simply and accurately unfolded.

This is the most complete, readable, popular account of electricity now available to the layman. It is an excellent supplementary reference for the secondary physical science student, whether in high school or college, and for the elementary, junior high or secondary science teacher. There are numerous illustrations and photographs.

The author is a writer and research scientist of note. For more than thirty years he was an electrical engineer and has many inventions to his credit.

—C.M.P.

PRYOR, WILLIAM CLAYTON, AND PRYOR, HELEN S. *Water—Wealth or Waste.* New York: Harcourt, Brace and Company, 1939. 242 p. $2.50.

Here is a book on conservation that you will like, and it should have a wide appeal because of the realistic way in which water conservation has been handled. The Pryors have long had the reputation of making everyday subjects interesting; but this time they have not only taken the vast subject of water and its importance to peoples everywhere down "history's highways" and today, but in each chapter they have discussed water in relation to people. For this reason, it is good reading for anyone. Teachers of social science and science will welcome this new book for it represents a type of procedure that can help to give a conception of conservation often lost in technical literature no matter how popular the material may be. The table of contents invites you to read: "There's Water in the Air," "Water Makes the Farm Go," "Water for Fun," "Dirty Water," "Floods," "Flood Control," "Water is for People," and conservation is "Everybody's Job." The photographic illustrations themselves portray vividly the drama of water. "Hide draped over bones" is an unforgettable picture of drouth. In visualizing the world's most valuable natural resource, the Pryors have had at their service the National Resource Commission, the Soil Conservation Service, the U. S. Bureau of Mines, and the U. S. Weather Bureau. —Greta Oppe.

REED, W. MAXWELL. *America's Treasure.* New York: Harcourt, Brace and Company, 1939. 395 p. $3.00.

Science instructors recognize that the books *The Earth for Sam* and *The Stars for Sam* are excellent. This book, written by the same author and edited by Dr. Carey Croneis of the University of Chicago, answers many questions about America's natural resources.

The author discusses such varied subjects as how the metals came, mercury, borax, copper, lead, silver, iron, aluminum, phosphorus, coal, petroleum, building stone, erosion, American versus world production, hoarding gold and silver, telescopes, inventions, the Olympic games, origin of American vitality, and the future of America.

This book could be used profitably by students of the secondary school. The 143 full page photographs are outstanding because of their number, clarity, and pertinence. The author has that unusual ability of explaining difficult theories so that they are easily understood.

—Roy V. Maneval.

QUINN, VERNON. *Stories and Legends of Garden Flowers.* New York: Frederick A. Stokes Company, Inc., 1939. 245 p. $2.50.

After reading this beautiful and delightful book we are conscious of how little we know of what is hidden in the names of our common flowers. We may never have associated the gladiolas with the sword or the narcissus with a narcotic. We may have wondered why the forget-me-not was called "scorpion-grass" in England and "mouse-ear" in France. The legends of the origin of the name "forget-me-not" in other European countries are charmingly told. And so it is with all the fifty different common flowers whose legends have been ferretted out of many different lands. Not least in your enjoyment of this book are the distinctive drawings of Marie Lawson.

—W.G.W.

SITWELL, SACHEVERELL. *Old Fashioned Flowers.* New York: Charles Scribner's Sons, 1939. 193 p. $6.50.

The author has gone back 100 years and in some cases 200 years to trace the origin of some of the beautiful flowers which made the old English gardens so attractive. There are many suggestions for those who like to make old fashioned gardens today. There are black and white drawings but the striking illustrations are the very unusual lithographic color plates of John Farleigh who is well known for his illustrations done for Bernard Shaw. The list of color plates is as follows: Auricula Theatre, Green Edged Auricula, Polyanthus, Tulip, Two Old Laced Pinks, Dahlia, Camellia, Red Moss Rose, Louise Odier Rose, Madary Pierre Oger Rose, and Fuchsia. —W.G.W.

PEATTIE, DONALD CULROSS. *Flowering Earth.* New York: G. P. Putnam's Sons, 1939. 247 p. $2.50.

The first two chapters telling how the author came to have his interest in plant science should be read by every teacher. From the "big men of science" on the Harvard faculty who were given the elementary courses he gained not the details of the pure science but a sense of scientific spirit which he expressed as follows:

> They brought discipline to cap the spouting of youthful convictions. They taught us to postpone judgments, to acknowledge mistakes, to mistrust your own work and give cordial credit to others', to assume nothing from particular instance, to search for contrary evidence as if it were pearls, to walk all around a question, to define a problem, to finish what you began. These are some of the commandments, and if we did not keep them any better than God's, mercy shown to the ignorant could no longer be ours (p. 13).

Of his contact with other sciences than the botany in which he was specializing (made through exchange of views with fellow students) he writes:

> So I became secretly persuaded that the value of a specialty was to learn it not in a specialized way but connectively, excursively, in its relation to the allness of things (p. 14).

After speaking of the complete divorcement of the "thorough grounding of theory" from its application in a real way he says:

> Except for one splendid course in the plant diseases, I never heard mention of an economic aspect of my subject. Pure science was never purer; such a training fitted one perfectly to teach it to future teachers (p. 15).

Finding satisfaction neither in the pure theory divorced from application, nor in the routine of economic botany as seen through government service he became interested in ecology, which he defines as "the sociology of plants," as revealing great implications behind the surface of nature. After these first two brief chapters of biography the author simply and beautifully relates what the scientist sees in the life of plants, greatly enlivened by personal comment on fellow students, professors and events. This is a truly unifying book, interweaving with the central theme of plant life and evolution, fragments and relationships with other branches of science. In the words of the jacket review it "integrates it all into a bracing and broadening concept of the whole of life." It is seldom that a book presents such a significant treatment of science in writing of such high literary quality.

—O. E. Underhill.

QUICK, ARTHUR CRAIG. *Wild Flowers of the Northern States and Canada.* Chicago: M. A. Donohue and Company, 1939. 518 p. $4.00.

The author has used an original and unique method of describing the wild flowers. Each week through the season he takes the reader for a hike. He explains each wild flower that is in bloom that week, giving much information about each species. The many interesting incidents mentioned gives one a feeling of having first-hand, intimate knowledge about the tricks and characteristics of each individual flower. A quiet vein of humor pervading the entire book renders it intensely interesting as well as instructive.

Life cycles, habits, traits, haunts, range, and frequency of some 600 species of wild flowers are given. A color key should add much to the practicality of the book. There are descriptive line drawings of most, if not all, flowers. The weekly approach as an aid to identification should make this guide especially useful to the beginner in flower identification. Elementary science, general science and biology teachers, as well as students in the latter class, should find this an excellent key. —C.M.P.

DITMARS, RAYMOND L. *North American Snakes.* New York: Doubleday, Doran Company, Inc., 1939. 305 p. $3.50.

This is a field book for identifying the snakes found in North America. It is divided into three sections, North Eastern, South Western, and Western. At the beginning of each section a key helps in the identification. There is separation in each section into two groups, poisonous and non-poisonous. In each group all snakes found in that section are included. The key is followed by description of physical characteristics, size, color, distribution or range, and habits of each snake. The general reader will be interested particularly in the more than one hundred photographs included in the forty-eight half-tone plates at the end of the book and in the chapter on the treatment of snake bites. The book is not just a nature book. It is an authoritative scientific work for the identification and classification of snakes.

—W.G.W.

PERRY, JOSEPHINE AND SLAUSON, CELESTE. *Forestry and Lumbering.* New York: Longmans, Green and Company, 1939. 128 p. $1.50.

This is the second book in the series America at Work. *Forestry and Lumbering* is intended for grade teachers and has as its major purpose that of making grade-school pupils interested in forestry work. The text recounts the progress of lumbering and the growth of forestry. Every effort was made to gather material from reliable sources and the manuscript was checked for inaccuracies by forestry experts. Numerous photographs enhance the work.

Chapter headings include: (1) Forests, (2) Forests in America, (3) Forest Regions, (4) The Growth of Forestry in America, (5) Education: The way to Success, (6) The United States Forestry Service, (7) State Forestry, (8) Forest Fires, (9) Fire Control, (10) Lumbering Moves On, (11) A Typical Logging Operation in the Douglas Fir Region, (12) The Typical Northwest Sawmill, and (13) Future Forests of America.

This is an excellent book for elementary and secondary science classes, especially for units on conservation of natural resources.

—C.M.P.

HOOTEN, EARNEST ALBERT. *Twilight of Man.* New York: G. P. Putnam's Sons, 1939. 308 p. $3.00.

With the exception of Chapter VIII, this book includes a series of nine lectures delivered at various times and places by Professor Hooten, Professor of Anthropology at Harvard University. They are discussions of man's biological ancestry and his place in the present regime of law and order upon the earth. Although the lecture content is not always mutually exclusive in the separate lectures, there is a fairly well developed sequence from the Simian basis of man's biological heredity to man's peculiar function as the carrier of intelligence and culture, the making and mixture of human races, change and decay in Americans, marks of a chosen people, prospects with regard to human liberty, and man's future control of his own destiny. The thesis in general is that man's evolution is not necessarily and surely upward but that elevation will come only through the utilization of his intelligence in studying the past record of biological development and planning and directing, by selection and elimination, what he wills to be.

The language is interesting if not always simple. Humor is interspersed wisely. The fundamental attitude of the anthropologist is brought out clearly. The book should be available to all alert students of natural science as well as to students desiring general information.

—A.W.H.

CONANT, ROGER AND BRIDGES, WILLIAM. *What Snake Is That?* New York: D. Appleton-Century Company, 1939. 155 p. $2.00.

This is an especially valuable identification guide. A map divides the United States east of the Rockies into six areas. The snakes in each area are grouped into four categories on the basis of type of scale (keeled or smooth) and type of anal-plate (simple or divided). This reduces the number in each group to a dozen or so. Brief written descriptions and page numbers then refer to detailed references with descriptions. The identification key is preceded by a few pages each on "The Way of a Serpent," "The Treatment of Snake Bite" and a three page "dictionary" defining some dozen terms used in classifying snakes. It is the perfect field manual.

—O. E. Underhill.

"NETTEL." *Photography for Profit.* New York: Chemical Publishing Company, Inc., 1939. 218 p. $2.00.

This is the American edition of an authoritative book on the money-making possibilities of the camera by one of the leading whole-time free-lance photographers, who knows all the "tricks" of photography and all the "snags" which can beset a beginner. The book is a contribution to the field of photography because the subject matter is based on hard, personal experience. It is specially designed for the amateur photographer and is packed with practical information describing the types of pictures which have salable possibilities. The book is profusely illustrated with pictures showing what to do and what to avoid. The contents include:

The keynote of salable pictures, the markets, apparatus, the use of sets, lighting units, enlargements, lenses and stops, plates or films, press photography, "Hot News" photographs, the laws of copyright, how to approach the markets.

The book concludes with a list of classified markets for photographs.

—Greta Oppe.

HERSHEY, J. WILLARD. *The Book of Diamonds.* New York: Hearthside Press, 1940. 142 p. $2.00.

The head of the chemistry department at McPherson College, McPherson, Kansas, has given the public a book that it will thoroughly enjoy. He traces the history of these precious stones, their curious religious lore, and relates their properties and tests for genuineness, and then describes their synthetic manufacture. About fifty synthetic stones have been synthesized at McPherson College ranging in size from one millimeter (one-twenty-fifth of an inch) in diameter to two millimeters by one and one-half millimeter by one millimeter weighing one-thirtieth carat, the largest synthetic diamond on record. There are seven color plates showing fifty-two various kinds of precious and semi-precious stones in their natural color. The book will be especially useful to chemistry students where diamonds are discussed and their synthetic manufacture studied. The layman will be interested in the Union of South Africa where the diamond has built up a new empire by producing three-fourths of all the diamonds owned by the entire world. The average American stenographer today wears a finer stone in her engagement ring than the bejewelled royal lady of long ago due to better knowledge of cutting diamonds today. This and much more is revealed by Dr. Hershey in his recent book concerning this "thing of beauty."

—Greta Oppe.

MORTENSEN, WILLIAM. *Outdoor Portraiture.* San Francisco: Camera Craft Publishing Company, 1940. 112 p. $2.75.

Since a vast majority of photographs are taken of people, singly or in groups, outdoors, this book is a most timely and practical one. The author is one of America's best known photographers and his long practical experience is evidenced in *Outdoor Portraiture.* The book is detailed and complete, useful to both the amateur and to the experienced. The 113 illustrations are pertinent to the textual material. General problems discussed are: equipment for outdoor portraiture, the general problems of outdoor portraiture, handling the camera, lighting, backgrounds, arrangement of material, and four common problems.

—C. M. P.

HARRY, RALPH G. *Modern Cosmeticology.* New York: Chemical Publishing Company, Inc., 1940. 288 p. $5.00.

Modern Cosmeticology presents the principles and practices of modern cosmetics. Among the many topics discussed are: (1) emulsions, (2) cleansing creams, milks and lotions, (3) face packs and masks, (4) powder creams, (5) astringent lotions and skin topics, (6) lipsticks, (7) face powders, (8) sunburn and suntan preparations, (9) deodorants, (10) depilatories, (11) bath preparations, (12) dental preparations, (13) hair tonics, (14) hair shampoos, (15) mouth washes, and (16) eye lotions.

Various aspects of the above and other preparations are included and there are directions for preparing the better ones. For the latter reason, this makes the treatise an excellent reference for the secondary school chemistry class.

—C. M. P.